

HANDBOOK
OF THE
DESTRUCTIVE INSECTS
OF
VICTORIA.

PART III.

FRENCH.

Price 2/6.



WITH COMPLIMENTS

FROM

Secretary for Agriculture

A HANDBOOK

OF THIS

DESTRUCTIVE INSECTS

OF

VICTORIA,

WITH NOTES ON THE METHODS TO BE ADOPTED TO CHECK
AND EXTIRPATE THEM.

Prepared by Order of the Victorian Department of Agriculture

BY

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PART III.

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Contents.

CHAPTER	PAGE
Preface to Part III. - - - - -	5
Victorian Vegetation Diseases Act, with the Board's Report on the working of same - - - - -	7
XLIII. The Common Victorian Locust - - - - -	27
XLIV. The Wheat Aphis - - - - -	41
XLV. Apricot Beetles - - - - -	45
XLVI. Tomato Moth - - - - -	49
XLVII. The Blue-Gum Moth - - - - -	55
XLVIII. The Vine Curculio - - - - -	59
XLIX. The Plum Aphis - - - - -	63
L. The Banksia Borer - - - - -	67
LI. The Phytomyza Leaf Tunneller - - - - -	71
LII. Cut-Worm Moths - - - - -	75
LIII. The San Jose Scale - - - - -	85
LIV. The Painted Apple Moth - - - - -	95
LV. The Caper Butterfly - - - - -	101
LVI. The Wattle Goat Moth - - - - -	107
LVII. The Gum Emperor Moth - - - - -	113
LVIII. The Gum Saw Fly - - - - -	117
LIX. The Banksia Moth - - - - -	121
LX. The Acacia Borer - - - - -	125
LXI. The Wheat Moth - - - - -	129
LXII. The Triangular-marked Banksia Beetle - - - - -	135
LXIII. The White-eyebrowed Wood Swallow - - - - -	139
LXIV. The White-rumped Wood Swallow - - - - -	141
LXV. The Narrow-billed Bronze Cuckoo - - - - -	143
LXVI. The Pallid Cuckoo - - - - -	145
LXVII. The Restless Flycatcher - - - - -	149
LXVIII. The White-shafted Fantail - - - - -	151
LXIX. The Brown Tree Creeper - - - - -	155
LXX. The White-throated Tree Creeper - - - - -	157
LXXI. Tabulated List of Materials in general use for the destruction of Noxious Insects, with additions and personal observations - - - - -	159

APPENDICES.

Illustrations of Spraying Apparatus and other Machines used in the destruction of Insects, &c., &c. - - - - -	173
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ERRATA.

At pages 48, 49, 75, and 79, for *Heliothis* read *Heliothis*.

At pages 58 and 59, for *Orthorrhinus Kluggi* read *Orthorrhinus Klugi*.

At page 142, for *Grallira* read *Grallina*.

At page 140, for largest responsible read largely responsible.

At page 156, for *Sitella* read *Sittella*.

PREFACE TO PART III.

THE Third Part of "The Handbook of the Destructive Insects of Victoria" has been prepared on similar lines to those indicated in the preface to Parts I. and II.

As the work of publishing a complete account of the many pests to which our plants are subjected progressed, it was found almost impossible to adhere strictly to the former plan of bringing the insects attacking various fruit trees together, as new pests are continually making their appearance, which necessitates the more important kinds being dealt with first.

The large demand for the two previous parts points to the conclusion that the "work" is welcomed by those engaged in rural pursuits, in whose interest it has been prepared, and, by permission of the Victorian Department of Agriculture, Part IV., the plates for which are nearly ready, will be published as soon as possible, and as the work is not written for scientific entomologists, analysis of the parts of the various insects figured has not been given.

In the present Part, plates and descriptions of many of the most valuable of our insect-destroying birds are given, and it is hoped that these will be appreciated by those interested, and these will be added to in Part IV.

The engravings of new designs in spraying apparatus and other appliances necessary for well-regulated orchard work, also those of other subjects, are placed, for convenience sake, at the end of the book, and have been selected from the best and most up-to-date authorities, and upon these lines the "work" will be continued until completed.

C. FRENCH.

Melbourne, 1900.

VICTORIA.



ANNO QUINQUAGESIMO NONO

VICTORIÆ REGINÆ.

No. 1432.

An Act relating to Disease affecting Vegetation.

[2nd March, 1896.]

BE it enacted by the Queen's Most Excellent Majesty by and with the advice and consent of the Legislative Council and the Legislative Assembly of Victoria in this present Parliament assembled and by the authority of the same as follows (that is to say) :—

1. This Act may be cited as the *Vegetation* Short title.
Diseases Act 1896.

2. In this Act unless inconsistent with the subject- Interpreta-
matter or context— tion.

“Act” includes regulations made under this
Act.

- “Disease” means any disease affecting trees plants or vegetables and which the Governor in Council may from time to time by proclamation in the *Government Gazette* declare to be a disease within the meaning of this Act and whether or not caused by or consisting of the presence of insects or fungus :
- “Diseased” means affected with “disease” :
- “Fungus” means any fungus or vegetable parasite whatever which the Governor in Council may from time to time by proclamation in the *Government Gazette* declare to be a fungus within the meaning of this Act :
- “Insect” means any insect whatever which the Governor in Council may from time to time by proclamation in the *Government Gazette* declare to be an insect within the meaning of this Act, and includes any such insect in whatever stage of existence the same may be :
- “Owner or occupier” includes the agent of any owner or occupier, and also any joint owner or joint occupier :
- “Owner” includes any person holding any land under any lease or licence from the Crown, or any person deriving title from under or through such person :
- “Regulations” means regulations made pursuant to the provisions of this Act :
- “Tree” “plant” and “vegetable” shall respectively include the fruit or other product of any tree plant or vegetable and every part of any tree plant or vegetable (as the case may be) and the fruit or product thereof.

3. (1) The Governor in Council by proclamation in the *Government Gazette* may either absolutely or subject to any regulations prohibit the importation introduction or bringing into Victoria or any portion of Victoria specified in such proclamation of any tree plant or vegetable which is in the opinion of the Governor in Council likely to introduce any disease or insect into Victoria or any portion of Victoria, and may at any time alter or revoke any such proclamation.

Importation of plants liable to introduce disease &c. may be prohibited.

(2) The Governor in Council by proclamation in the *Government Gazette* may either absolutely or subject to any regulations prohibit the bringing into any portion of Victoria from any other portion of Victoria specified in such proclamation of any tree plant or vegetable which is in the opinion of the Governor in Council likely to spread any disease or insect in Victoria, and may at any time alter or revoke any such proclamation.

Transfer from one portion of Victoria to another may also be prohibited

(3) Any person who imports introduces or brings or causes or knowingly permits to be imported introduced or brought into Victoria or into any specified portion of Victoria any tree plant or vegetable contrary to any prohibition contained in any proclamation shall be guilty of an offence against this Act.

Importing &c. tree plant or vegetable contrary to proclamation an offence.

4. (1) No person shall import introduce bring or cause or knowingly permit to be imported introduced or brought into Victoria any insect or fungus except for scientific purposes only and with the consent of the Minister.

Importing insect or fungus prohibited.

(2) Any insect or fungus or any tree plant or vegetable imported introduced or brought into Victoria contrary to this Act or any diseased tree plant or vegetable imported introduced or brought into Victoria and any package or case containing or

Insects plants packages &c. may be seized.

suspected to contain any such insect fungus tree plant or vegetable may forthwith be seized by any person so authorized in writing by the Minister either generally or specifically and shall be destroyed or otherwise dealt with as the Minister may direct.

Destruction
of diseased
trees plants
&c. by
order of
Minister.

5. If in the opinion of the Minister the destruction of any diseased tree plant or vegetable whether the same was or was not imported introduced or brought into Victoria is a matter of necessity and extreme urgency he may make an order in writing directing the destruction of such diseased tree plant or vegetable by any inspector or person referred to in such order.

Failure to
comply
with direc-
tion of
Minister to
eradicate
disease.

6. The Minister may, at any time, make an order in writing directing any person who is occupier or owner of any land or in charge or command of any ship or vessel upon or in which there is any diseased tree plant or vegetable, to take the measures and do the acts mentioned in such order for the eradication of any disease or the destruction of any insect or fungus. If within fourteen days after the service of such order upon such person he does not take such measures or do such acts as are directed therein he shall be guilty of an offence against this Act.

Persons
authorized
by Minister
may enter
upon land
to search
for disease.

7. If proof be given to the satisfaction of the Minister that any trees plants or vegetables suspected to be diseased are growing or are upon any land he may authorize in writing any person to enter upon such land at any time with or without any assistants to search for diseased trees plants or vegetables and to remain thereon so long as may be reasonable for such purpose.

Notice by
authorized
person to
occupier or
owner to
destroy
insects or
fungi.

8. When any person authorized as aforesaid finds diseased trees plants or vegetables upon any land such authorized person may by notice signed by him require the occupier or owner of such land to

eradicate all disease from and destroy all insects or fungi on all trees plants or vegetables then growing upon such land ; and such authorized person may at any time enter upon such land to ascertain if such notice has been complied with.

9. (1) At the expiration of twenty-one days from the date of the service or giving of such notice such authorized person may if he think fit summon the occupier or owner of the land to whom such notice was directed to appear before a court of petty sessions.

Owner
occupier or
lessee
failing to
destroy
insects or
fungi.

(2) If in the opinion of the court the occupier or owner has failed or neglected to eradicate all disease and destroy all insects or fungi as directed in such notice, the court may make an order in writing authorizing such person or any other person to enter upon such land at any time with or without assistants and to eradicate all disease and to destroy all insects or fungi on all trees plants or vegetables then growing or upon such land.

(3) Every such person shall in any court of competent jurisdiction or in a court of petty sessions be entitled to recover from such occupier or owner the expenses of such eradication and destruction together with costs.

10. (1) If there is no occupier of any land or the occupier or owner is unknown to the Minister or absent from Victoria and the Minister cannot ascertain that such occupier or owner has any agent in Victoria, then any notice or order under this Act shall be affixed in some conspicuous place upon such land and a copy thereof shall also be published in some newspaper circulating in the neighbourhood thereof. Every such notice or order so affixed and published shall be deemed and taken to be a sufficient notice or order to the occupier or owner of such land from the time of its being so affixed and published.

Where no
occupier of
land notice
or order
may be af-
fixed in
some con-
spicuous
place on
land.

(2) It shall not be necessary for any such notice or order to specify the name of any person as occupier or owner of the land therein referred to in such notice or order.

Proceedings
against
occupier in
first
instance.

11. No proceedings shall be taken against any owner of land for failing to comply with any notice or order to eradicate all disease from or destroy insects or fungi on trees plants or vegetables upon any land until the provisions of this Act have been enforced against any occupier of such land upon which such insects or fungi are found.

Proclama-
tion by
Governor
in Council.

12. (1) The Governor in Council may by proclamation in the *Government Gazette* order that certain trees plants or vegetables specified in such order shall not be removed from or out of any nursery orchard or place the boundaries whereof shall be defined in such order ; and may at any time alter or revoke any such proclamation.

Removing
plants &c.
contrary to
proclama-
tion
prohibited.

(2) No person shall remove or carry away or order cause or knowingly permit to be removed or carried away from or out of any such nursery orchard or place any tree plant or vegetable contrary to the terms of such proclamation.

Regulations.

13. (1) The Governor in Council may make regulations for all or any of the following purposes, viz. :—

(a) for prescribing the form of notices and orders to be given under this Act and the time when and manner in which such notices or orders are to be given :

(b) for securing the effectual treatment of diseased trees plants or vegetables and the effectual eradication of disease and destruction of any insect or fungus :

- (c) for prohibiting or regulating the importation introduction or bringing into Victoria or any specified portion of Victoria or the transfer or removal within Victoria of any particular kind of tree plant or vegetable likely in the opinion of the Governor in Council to spread any disease or insect :
- (d) for prescribing penalties for the breach of any regulation not exceeding for a first offence One pound and not exceeding for any subsequent offence Ten pounds :
- (e) for defining the boundaries of any portions of Victoria to be called fruit-growing districts and for providing for the election by the fruit-growers of each such district of a local board of advice and for providing for the calling of meetings of and the conduct of the proceedings of such board and also for the appointment by the Governor in Council of a central board of advice, such boards to consist of not less than three and not more than seven members ; and for prescribing the respective duties of such boards and the tenure of office of the members thereof :
- (f) for prescribing the duties of inspectors appointed under this Act : and
- (g) generally for carrying into effect the provisions of this Act.

(2) All such regulations upon being published in the *Government Gazette* shall be valid in law as if the same were enacted in this Act and shall be judicially noticed ; and all such regulations shall be laid before both Houses of Parliament within fourteen days after the making thereof if Parliament

To be laid
before Par-
liament.

be then sitting and if Parliament be not sitting then within fourteen days after the commencement of the next session of Parliament.

Offences.

14. (1) Every person shall be guilty of an offence against this Act—

Obstructing
execution
of Act an
offence.

(a) who in any manner obstructs or impedes or attempts to obstruct or impede any person acting under the authority direction or order of the Minister or of a court of petty sessions in the execution of such person's powers under such authority direction or order under this Act, or

Disobeying
orders &c.

(b) who disobeys or fails to comply with any of the provisions of this Act or any direction or order given pursuant to such provisions.

Penalty.

(2) If any person is guilty of an offence against this Act for which no penalty is specially provided he shall for every such offence be liable on conviction to a penalty not exceeding Twenty pounds.

Limitation
of actions
&c.

15. No action shall be brought against any person acting in the execution of this Act for anything done thereunder unless the same be commenced within four months next after the act complained of has been committed.

No autho-
rized per-
son liable
for damage
unless
wilful.

16. (1) No person acting under the authority direction or order of the Minister or of a court of petty sessions in the execution of this Act shall be deemed to be a trespasser by reason of any entry or removal or destruction under this Act, or be liable for any damage occasioned in carrying out such authority direction or order under the provisions of this Act unless the damage was occasioned by such person wilfully and without necessity.

(2) No person shall be entitled to receive any compensation whatsoever in consequence of any measures taken for the eradication of any disease or the destruction of any insect or fungus or of any prohibited or diseased trees plants or vegetables, or in respect of any damage that may result to him therefrom either directly or indirectly unless the same was occasioned wilfully and without necessity.

No compensation allowed for damage occasioned by carrying out this Act unless wilful.

17. The Governor in Council may appoint subject to the Public Service Acts as many inspectors as may seem necessary for carrying into effect the provisions of this Act and may remove any such inspectors.

Appointment of inspectors.

18. This Act shall continue in force until the first day of January One thousand eight hundred and ninety-nine and thence until the end of the next ensuing session of Parliament.

Duration of Act.

REPORT ON THE WORKING OF THE VEGETATION DISEASES ACT 1896.

OBJECTS FOR WHICH THE ACT WAS FRAMED AND PASSED BY PARLIAMENT.

The Vegetation Diseases Act which came into force on 2nd March, 1896, was passed at the instigation and in the interests of the fruit-growers of the colony with the object principally of advising orchardists, nurserymen, and others as to the best and most economical methods of keeping their places free from insect and fungous diseases ; also to enable them to place their produce on the market in the best condition possible. It was also felt that whilst many persons exercised great care, and went to much expense in keeping their places clean, there were many who did not take this trouble, consequently rendering the efforts of those people inoperative ; in which case the Act enables the Department to take action and compel these persons to keep their orchards, &c., free from disease.

APPOINTMENT OF A CENTRAL BOARD OF ADVICE.

The Governor in Council, under section 13, sub-section (e) of the Act, appointed a Central Board of Advice on the 15th May, 1896, consisting of Messrs. J. Harris, M.L.A. (Chairman), the Hon. W. Anderson, G. Neilson, C. French (Government Entomologist), and D. McAlpine (Government Pathologist). Regulations under the Act were framed by this Board and approved of by the Governor in Council. The first meeting of the Board was held on 14th May, 1896, and meetings have been

held regularly ever since. The Board felt the loss of Mr. Neilson's services by death in January, 1898. His services were of great value, and the vacancy caused by his decease has not yet been filled.

REGULATIONS.

The regulations provide for the steps to be taken by growers and importers in dealing with disease ; the duties to be performed by inspectors ; the manner of appointment and election of local boards of advice with their duties ; instructions to persons dealing with the scheduled diseases ; dividing the colony into fruit-growing districts ; and for the inclusion of insect and fungous diseases under the Act.

So as not to make the working of the Act too cumbersome at the start, only as few diseases as it was found actually necessary at the time to proclaim were gazetted, viz., five (5) insect diseases and three (3) fungous diseases. As occasion arose more were added, and approved by the Governor in Council, viz., five (5) additional insect and two (2) additional fungous diseases ; the total at the present being ten (10) insect and five (5) fungous diseases. Others will be added as circumstances arise.

LOCAL BOARDS OF ADVICE.

The regulations provide for the appointment of a local board of advice for each fruit-growing district by the fruit-growers, who are at liberty to register their names with the returning officer for each district. This course has not so far proved a success owing to want of interest on the part of the growers themselves, except in five instances. Out of ten districts only five complete boards were elected by the growers, notwithstanding the fact that each board was to consist of seven members only.

We think that this difficulty might be met by the local boards of advice being made nominee boards,

appointed by the Governor in Council, and would recommend that the Act be so amended as to provide for this. We would further recommend that an amendment be also made in the direction of compelling every fruit-grower in the colony to register his name with the returning officer for the district in which such fruit-grower resides. This step would facilitate the work of the inspectors in making their examinations of orchards as thorough as possible.

APPOINTMENT OF INSPECTORS.

The colony having been divided into ten (10) fruit-growing districts, it was thought necessary by the Board to appoint one inspector to each district ; and to make the system of inspection as thorough as possible a staff of at least twelve (12) inspectors would be required. This course was recommended to the Minister of Agriculture. As a commencement two (2) were appointed, the date of the first appointment being 19th February, 1898. Since then the staff has been added to from time to time until at the present time the number has been increased to seven (7) fully qualified inspectors, with two (2) temporary junior assistants for city work. The whole of these, with the exception of the two juniors, were appointed from other Departments of the Civil Service, all being required to pass a competitive examination in practical entomology and mycology, &c., &c., the examiners being Messrs. French and McAlpine. The inspectoral staff has been attached to the Entomological Branch of the Department of Agriculture, with Mr. C. French as Chief Inspector.

INSPECTIONS.

Orchards, Nurseries, and Gardens.

Upon examination, many of the orchards, &c., of the colony were found to be in a more unsatisfactory state, as far as diseases were concerned, than was expected.

Up to date, 3,800 places have been visited by the inspectors, who have given the necessary instructions. In addition, a number of these have been revisited, to see if their instructions have been carried out. In four cases it has been found necessary to institute proceedings against occupiers for non-compliance with regulations, in each of which cases the prosecution was successful. Further, some orchardists at first showed an unwillingness to comply with instructions ; but, after serving them with notices to clean, satisfactory results were obtained.

Nurseries.

The system inaugurated of inspecting nurseries, and of issuing certificates to clean, has been found to work well ; 47 nurseries have been examined and granted "clean certificates," which hold good for six months. The other colonies accept our certificates of cleanliness accompanying trees sent. This not only facilitates the work of the inspectors, but the improved condition of our nurseries is noticeable in a marked degree. The number of certificates issued by the Government Entomologist on nursery stock exported from the colony is 1,600, being an average of about 1,000 per annum. There are also a number of nurseries that only grow cut flowers for market, and, although they are generally clean, it has not been found necessary to issue them "clean certificates."

ABANDONED ORCHARDS.

Some three years since, at the suggestion of the Government Entomologist, an estimate was made of the number of acres of abandoned orchards within a 10-mile radius of Melbourne, and it was found that there were something like 700 acres, at a low estimate. These orchards consist of land on the outskirts of the suburbs, purchased by land syndicates in the boom time, with the object of their being cut up into building allotments for sale. These are now being dealt with. Great difficulty

exists in dealing with them and in finding the owners of the places, many of which are unoccupied and still owned by syndicates. They are a menace to genuine orchardists, being veritable breeding-grounds and nurseries for noxious insects and fungi. One inspector is occupying the whole of his time in examining these. We hope that before long these abandoned orchards will cease to exist, the Act giving the inspectors power to destroy all trees which are past redemption, after serving notices on the occupiers or owners.

FRUIT IMPORTATION.

Whilst compelling all fruit-growers to eradicate disease, the Board found that there was great danger of their efforts in this direction to some extent being nullified, unless strict supervision were exercised in the examination of fruit and fruit trees imported. As showing the nature of this work of inspection at the wharfs and rail stations, the whole time of one inspector and two assistants is devoted to this work. In Queensland and New South Wales great damage is done to fruit by two species of fruit flies—the Queensland and European. Great apprehension exists amongst our fruit-growers for fear of the introduction of one or both of these pests. Up to the present time, owing mainly to the strict supervision exercised by our inspectoral staff, neither of these pests has made its appearance. The magnitude of this work will be realized when it is stated that during the fruit season 468,154 bunches of bananas were imported by sea into the colony; 13,775 bunches and 911 loads of refuse having been condemned and destroyed up to date on account of disease. Of citrus fruits alone 334,260 cases have been imported up to date, of which 11,832 cases have been condemned and allowed to be transhipped elsewhere.

In the case of citrus fruits imported from the other colonies, certificates as to the same having been treated

with hydrocyanic gas under Government supervision must accompany such fruit before it can be admitted, we reserving to ourselves the right of inspection, even if the fruits are so accompanied. In the case of bananas and other soft fruits, which could not be so treated, each consignment must bear a certificate to the effect that it has left the port of shipment in a clean condition. The general improvement in the fruit imported (except in the case of citrus fruits from New South Wales) is very marked, especially with citrus fruits from the continent. In view of the danger which exists of introducing on trees new diseases into the colony, a cyanide chamber has been erected at the Horticultural Gardens, Burnley, to which all imported trees are sent, and there treated for one hour. Owing to the distance of this chamber from Melbourne, it is found that the importer has to put up with much inconvenience by having to send his trees there to be treated. The Board is of opinion that a disinfecting plant erected at some place more convenient to the port of landing would be more advisable. This treatment of trees has been found by experience to be very fatal to all insect life, especially, and if properly managed, without injury to the plants. In the retail fruit trade there is yet much to be done. We think that a systematic inspection of fruit shops and markets should be made. A large amount of inferior fruit is offered to the public in these places ; and, although such fruit is not necessarily diseased, it is much below the standard of what should be expected in Victoria.

The use of old and second-hand cases is much to be deprecated, and, as these are undoubtedly the means of disseminating disease, the importance of this matter cannot be overrated. All cases before being used a second time should be thoroughly disinfected, and cases not disinfected should be destroyed. Each grower should possess the necessary means of dipping his cases, according to clauses 7 and 9 of the regulations.

EXPORT OF FRUIT.

The export trade in fruit to the other colonies has been very large, and demands constant attention by the inspectors. The Governments of other colonies insist on fruit received from Victoria being accompanied by a certificate from our inspectors that it is free from disease when shipped. This entails a great deal of work on our staff. So as not to put the exporter to inconvenience much of this inspection has to be done outside office hours, at all times during daylight.

GENERAL REMARKS.

On the whole we find that the Vegetation Diseases Act has been of great benefit to the colony. Monthly reports from inspectors to the Board show that growers are fully alive to the importance of producing nothing but sound and clean fruits. They are always willing to adopt suggestions made by the inspectors, and show great appreciation of the trouble taken to afford them instruction, not only in the orchard, but also by means of lantern lectures. It is only fair to the inspectors to say that they have shown much aptitude for their work. The scope of our inspection is much more advanced than that of the other colonies, Tasmania and South Australia with Victoria being the only ones which make orchard inspection a feature of their work.

It has been found that there are many plants growing in our public parks, gardens, and reserves diseased; and a thorough inspection of these has been made, the attention of the curators in each instance being directed to the urgent necessity of eradication of all disease. There are also many private gardens in the colony, both large and small, in which occur a few fruit trees. Many of these cases, which are amongst the worst, are being dealt with, but owing to their being numerous and so scattered, the matter of dealing with them is necessarily difficult, and they will take some time to be effectively dealt with.

To make the Act more effective it is necessary that the staff of inspectors be increased to the number originally recommended by the Board, viz., twelve. There are now only seven (7), and they have to spend a large amount of their time in Melbourne, inspecting both exported and imported fruit. The export of fruit is increasing year by year, and there is every probability that it will reach very large dimensions.

So far there has been very little friction in working the Act ; and as we are looking forward to a large expansion of our fruit-growing industry, we are of opinion that, seeing there is a permanent measure in each of the other colonies for dealing with diseases in fruits, the continuance of this Act is fully justified, and that it should be made a permanent measure.

On behalf of the Board,

JOSEPH HARRIS,

10th August, 1899.

Chairman.

PLATE XXXVII.

"COMMON VICTORIAN LOCUST" (*PACHYTELUS AUSTRALIS*, BR.).

Fig.

1. Eggs of Locust. Natural size, from nature.
2. Newly-hatched Insects. Natural size, from nature.
3. First moult. Natural size, from nature.
4. Second moult. Natural size, from nature.
5. Male Locust. Natural size, from nature.
6. Female Locust. Natural size, from nature.
7. Ovipositor of Female. Slightly magnified, from nature.
8. Ventral view. Slightly magnified, from nature.
9. Braconid Fly. Natural size, from nature.
10. Braconid Fly. Natural size, from nature.
11. Perfect Insect, side view. Natural size, from nature.
12. Portion of perfect Insect with Trombid Mite attacking same.
Magnified, from nature.
- 12A. Mouth of Locust. Magnified.
13. Trombid Mite. Magnified.
14. Trombid Mite. Natural size, from nature.
15. Skin of Locust after moult. Natural size, from nature.
16. Fly which attacks Locusts. Natural size, from nature.
17. Portion of wing of same. Magnified, from nature.
18. Head of Fly attacking Locusts. Magnified, from nature.
19. Head of young Locust. Natural size, from nature.
20. Locust attacked by Ichneumon Fly. Natural size, from nature.
21. Portion of Locust. Magnified, from nature.
22. Mouth of Locust. Magnified, from nature.
23. Egg deposits with newly-hatched insects. Natural size, from nature.





18



16



17



15



13



12



12A



14



22



11



20



19



21



23

DESTRUCTIVE INSECTS OF VICTORIA.

CHAPTER XLIII.

THE COMMON VICTORIAN LOCUST.

(*Pachytelus australis*, Br.)

Order: *Orthoptera*. Family: *Acrididæ*.

This terrible scourge, which when fairly on the wing, carries desolation to all living herbage, is not by any means confined to Victoria, where there are several other so-called locusts, the above-named insect, as it is strictly migratory, being the most destructive of all, and in a report by Mr. R. Helms, then connected with the New South Wales Agricultural Department, who went afield specially for the purpose of studying the habits of these insects, he makes the following remarks, which will apply to the conditions obtaining in Victoria:—

“It seems that the locust is most destructive before maturity or the winged stage is reached. When the time arrives food becomes the secondary and pairing the primary object of the two sexes, the numbers of which are about equally divided. Immediately after pairing, the females bore holes into the hard ground, with great dexterity and rapidity, to a depth of $1\frac{1}{2}$ to 2 inches, by about $\frac{1}{4}$ inch in diameter. This is done by means of a double horny process (see Plate XXXVII., Fig. VII.) attached to the last segment of the body, assisted by the secretion of a white frothy substance, and by the muscular

contractions and expansions of the body, which, in many cases, becomes almost transparent. The females now begin to lay regularly and closely in a quadruple row (see Fig. XXIII.), placed diagonally to the direction of the bore. The number laid by each female varying from 50 to 80, or more, and these are compacted into a tube about an inch long, and appear to be protected from the heat by a white frothy secretion. About six hours are occupied in this operation, during which time the female cannot readily escape, and frequently succumbs to the attacks of ants, &c., the eggs, whilst in the female, are yellow, with a bright greenish tinge; when deposited they assume a dirty flesh colour, and in a few days become a dirty yellow. After the eggs are deposited they expand to sometimes twice their size, whilst the shells gradually harden. My observations suggest the probability that there are two broods in a year. The eggs deposited about October or November will, on account of the summer heat, be hatched within a month: whilst those deposited in March will hybernate during the winter and be hatched about September. The favorite places for depositing the eggs are gentle slopes, free, or almost so, from vegetation; also cattle and sheep tracts, roadways, plains, &c., and I noticed in one place that they had deposited in a recently planted vineyard, probably because the surrounding country was covered with vegetation. These breeding grounds are readily recognisable, for the ground is broken into small clumps of earth, $\frac{1}{4}$ to nearly $\frac{1}{2}$ an inch in diameter, which often lie about indiscriminately as if the land had been scarified by a pronged hoe. The nests are so close together that there are about 150 to 200 to the square foot, and the females when laying frequently overlap each other. The young come out of these nests in a mass, and remove themselves out of the eggs by means of their hind legs. They are at first of a very pale flesh colour, with markings about the legs and body, at first very faint, but which in less than 48 hours, become very distinct, whilst the ground colour changes

into a bright fleshy pink. These colours remain until maturity is reached, which is about three months from the time when they are hatched."

This, then, is a fair description of the insect in the open air, but in confinement I have reared the insect from the eggs to the perfect insect in a little over two months from the time of confinement in the breeding cage.

Prevention and Remedies.

In Australia but little has been done in the way of combatting these pests, the principal breeding grounds being in the drier parts of New South Wales, and from whence the immense swarms which we sometimes see are reared and distributed, the Murray and other rivers affording but slight obstacles to the insects when once on the wing. In our own colony we have numerous breeding grounds, especially in the north-west districts, for these destructive pests, and unless much more interest is shown by growers in the matter it is feared that we will have, of our own breeding, quite sufficient of these home-reared locusts to stock at least the whole of the northern parts of Victoria. In Algeria and Cyprus, also in America and other locust-infested countries, various devices, some of which are illustrated here, are in use for the purpose of checking the advance of these pests, the best of which is the so-called locust-screen (see Appendices), which is prepared as follows:—Strips of cotton texture of different lengths, and about 2ft. 6in. wide, with an upper edge of oilcloth, or American glazed leather, about 6 inches broad, are stretched in a given direction by means of wooden pegs and ropes, and lead to a trench 3 feet broad and 3 feet deep. The young locusts are driven in the direction of these screens; they cannot climb over the glazed surface above, and they are then led by sheer pressure from behind to the trench, which is often, where the soil is too light for the sides to remain perpendicular, lined with sheet-iron or has a horizontal projecting sheet on each side, forming a

sort of cave, which prevents the escape of the insects. The locusts are now despatched in the trenches by means of glowing embers in places where wood is abundant, or by means of chemicals, such as bisulphide of carbon, creosote oil, or other gas refuse. When these trenches are filled by locusts the first screen is let down, by unfastening the ropes, and the swarm proceeds to encounter a few yards beyond a second series of screens and trenches, or more, according to requirements; care must, however, be taken not to have the line of screens outflanked by the swarm in motion. This will be done by a little care and practice. The advantage of the screen system over all others being its thorough efficacy, and also its cheapness. Two or three farmers can combine for the purchase of 1,000 or 1,200 yards of screen to cope with small swarms. According to Mr. Roberts, of West Beaufort, in Cape Colony, the cost is about £2 per 100 yards, but doubtless screens made of hessian would be cheaper. (This information is supplied by Mr. Peringuey, of Cape Colony, a gentleman who has had a large experience in fighting the locusts in South Africa.) In Algeria and in Cyprus, where labour is cheap—and in the former country black labour is largely available—the screen system is no doubt an admirable one, as is also the system of collecting the eggs, both being preventives, so that the young locusts cannot assume the winged stage, when it is almost impossible to deal effectually with them. Various other measures have been tried with success, one of the best being the cultivation of the castor oil plant (*Ricinus communis*), also larkspur, in belts, across farms, grazing, and orchard areas, as whenever locusts eat these leaves, which they will readily do, the result is always fatal to them. Brush-harrows, chain-harrows, beating, smoking, and other plans have been tried; but, judging from the best and most reliable accounts, these have mostly been abandoned in favour of the Cyprus apparatus, viz., the screen system. Poisoning the food, too, is an excellent plan, which has

been tried with the best results at Mildura and elsewhere. The food is prepared by mixing together 35 lbs. of pollard, 25 lbs. bran, 25 lbs. arsenic, 2 gallons of water, and 6 lbs. of treacle. This must be thoroughly mixed, so that every particle of pollard and bran receives a portion of the arsenic. The mixture is applied by placing (boys can do this) a tablespoonful at the foot of each vine, supposing a vineyard has to be protected against an invasion, and the locusts, before reaching the leaves, will be attracted by the smell of the mixture and will always eat it in preference to the leaves. This mixture can also be scattered broadcast.

The so-called locust fungus (*Mucor racemosus*) which the Entomological Branch of the Agricultural Department has introduced from South Africa, is now being tried here. (See condensed reports on experiments and preparation of material.) In Victoria we have several insects which attack the locusts, some of which are shown on our plate, also by a "Trombid Mite," which (see Figs. XIII.—XIV.) cluster on the thighs of the insects, causing at least a much impeded locomotion. In New South Wales two dipterous flies—*Masicera pachytilis*, Sk., and *Tachina adipodæ*, Oll.—are reported to be great destroyers of locusts, and, according to a late valued correspondent (Mr. Buggy, of Corowa, N.S.W.), a Braconid fly had attacked from 60 to 70 per cent. of the locusts, many of which were found dead on the ground. Where valuable plants have to be saved, a weak kerosene emulsion (1 in 30), or Paris Green (1 lb. Paris Green, 6 lbs. lime, and 6 lbs. treacle, diluted with 160 to 180 gallons of water) will be found most beneficial. It must be remembered however that co-operation in this, as in most cases of the kind, is absolutely necessary, and as Mr. Perringuey has said—"Locusts are no more a visitation of Heaven than the phylloxera, the plague, or the murrain. That they can be successfully coped with is now beyond doubt, but not without the most perfect and unselfish co-operation."

A few words on the value of birds, as fowls, turkeys, &c., in the destruction of locusts may not be uninteresting. The common turkey is probably one of the best known and most valuable of insect destroyers, and turkeys about a third grown will soon fatten upon either locusts or grasshoppers, so that, in addition to keeping down the pest, they may also be turned into a source of profit. It may be well to remind growers that very young chicks should not be fed on either locusts or other insects. Many of the native birds, as the wild turkey, magpie, crow, heron, Nankeen kestrel, &c., are most valuable as locust or grasshopper destroyers, and it is no uncommon occurrence to see a swarm of crows so filled with grasshoppers as to be hardly able to fly. The common barn fowl is largely used in South Africa, where the locust plague is a most serious matter. Mr. Peringuey says—"If a few days before ploughing you put your fowls in a receptacle fixed on wheels which can be brought into the field, and whence the fowls will be let out in the morning, they will soon learn to go back to their perch in the evening, after having during the day eaten all insects or eggs that your plough will have turned up. Move them, fowl-house and all, in the night to where ploughing will be proceeded with the following morning, so that they may have their resting-place near."

The plan of trampling the young locusts by means of mobs of cattle, horses, or sheep, is an admirable one, and has been tried with great success, and, referring again to the egg collecting, it is stated that in the years 1881-2 as many as 1,330 tons of eggs are said to have been collected in Cyprus alone. Mr. Olliff further remarks that one of the easiest ways of collecting the eggs when they are found in large numbers is to take off about an inch of the soil with the spade, then to cart the earth and eggs to some sheltered place where it will have a chance of drying, and then to separate the egg masses by means of a sieve on the same principle as that used for gravel sifting, but the mesh, of course, must be finer. In

America Professor Riley has tried several plans by which the young locusts may be prevented from ascending trees, viz., by placing a strip of bright tin, 4 or 5 inches wide, tacked round a smooth tree, and in the case of trees with rough trunks a very simple and effective plan is recommended by the same scientist—"Take a piece of rope and tack it round the tree with the tin fastened on to it so as to leave a portion both above and below, any passages or holes that may be between the tin and rope, or rope and tree, being stopped up by filling the space between tin and tree with earth above."

The late Professor Riley, whose work in locust campaigns is so well known, warmly recommends the destruction of eggs which are, as previously stated, deposited in hard ground such as roads, open fields, &c., and we give his own words as quoted by the late Mr. Olliff, of Sydney—"As each female lays from 50 to 80 eggs or more, in a mass about half-an-inch below the surface of the ground, generally in bare and exposed places, and these egg masses or pods are placed so close together that 150 or 200 may often be found to the square foot, it is obvious that it is no very difficult matter to collect vast numbers of the eggs when the breeding grounds have been discovered. In Algeria, during the recent visitation of locusts, enormous quantities of eggs were collected by the Arabs, who were paid for their labour at so much per gallon.

The means of destroying the eggs which have been employed with more or less success have been described by Professor Riley under the following heads:—1. Harrowing. 2. Ploughing. 3. Irrigation. 4. Trampling. 5. Collecting. First with regard to harrowing. In the autumn, or during dry mild weather in early winter, this method will prove one of the most effectual means of destroying the eggs and preventing future injury. A revolving harrow or a cultivator will do excellent service in this way not only in the field, but along roadways and other bare and uncultivated places. The object should

be not to stir too deeply, but to scarify and pulverize the soil to about the depth of $1\frac{1}{2}$ inches.

The locust plague is a terrible one, as the insects are most voracious, and will tackle almost anything in the shape of vegetation, also other things when hard pressed for food, and no one who has suffered from their depredations, or has seen the locusts either at work or in flight, is ever likely to forget it. On the vast plains of Riverina, extirpation would be next to an impossibility, but where the breeding grounds are in our midst, concerted and energetic action might do a great deal towards a mitigation of the evil. Seasons such as we are now experiencing are favorable to the development of the young insects, but where the newly-hatched locusts have to depend upon dried up herbage for their food great mortality is the result.

Summary of Experiments with the Locust Fungus Disease at Rochester, 1899, from Field Observations by Inspector Cock.

Experiments in the field started on the 12th of October. For three weeks prior to this I had been traversing the northern infested areas, studying the swarms of locusts, and forwarding quantities to Melbourne for indoor experiments. Results were unsatisfactory, consequently Mr. French, the Government Entomologist, decided on the field experiments; these I strove to carry out under conditions as near to practical every-day working methods as possible, and infections were made on the 15th and 16th, after a fall of 38 points of rain preceded by an unusually dry spell, and followed immediately afterwards by strong dry winds, hot days, and no night dews. Between this and the 23rd three more infections were carried out in the swarms on the open plains, no results showing. On the 23rd, I fenced in 25 square yards on the

edge of the swamp at Restdown with hessian, and inside carried out the experiments on thousands of locusts in the hopping stages with both bread and water fungus, keeping the grass damp by watering every evening. The result in six days' time was really splendid, proving at once the efficacy of the fungus under moist conditions ; outside the fungus would not spread. Dry conditions continued until the 4th of November, rain fell copiously for three or four days after that, with a close muggy atmosphere. I infected with water fungus in three flying swarms during this time, and on the 11th I first obtained my success, since then locusts are to be found dying daily in hundreds in all stages, and all through the infected paddocks in a south-westerly direction dead locusts are to be found. I raised the fungus from the dead locusts in three days in moisture, thus proving the fungus was the cause of death ; and examination proved that the intestines were fully eaten up with the fungus, under unfavorable conditions, the mean sun temperature from the 12th October to the 4th November was 108.5° , shade 68.6° , rainfall 38 points ; under favorable conditions, from the 4th November to the 25th inst., the rainfall was over $1\frac{1}{2}$ inches, mean shade register 74.4° , sun 102° . From this we require that moist weather conditions are essential to the success of infection. In the nymph or hopping stages bread fungus can be easily and readily applied, grass and water are then plentiful, and dews at night will keep the fungus growing, and provide infected food for the locusts in that stage. At the end of October water fungus is undoubtedly the best and surest means of infection, and I recommend it in all its stages. It is easily grown at a temperature of anything from 65° to 100° , the warmer the better, but at 70° after three days from preparation it is quite ready for use, and the directions given are quite explicit. All that is necessary for infecting is a hoop-net, made of netting (mosquito), 2 feet in diameter, for the purpose of catching the locusts ; after capture dip them into the glass, then take them out

and let them go, and so on repeat until the glass is emptied of its fungus contents. The water must be cooled and boiled, also the corks. A tube of the fungus culture will make a copious growth on a basin of bread fungus in three days, and the fungus thus raised will make quite a quantity of water or other bread fungus. The bread is best for use when about four days old. Farmers can rely on this fungus disease as their friend, and should everywhere take up the work of extermination, which is not only useful but pleasurable.

NOTES ON THE PREPARATION OF THE LOCUST FUNGUS, AND USE OF SAME IN INFECTING LOCUSTS, THE FOLLOWING BEING THE METHODS AS SUCCESSFULLY ADOPTED IN OUR EXPERIMENTS.

Preparation of Water Fungus.

1st. Place two teaspoonfuls of sugar in a tumbler, open a tube, and remove the fungus contents entire, place this in the sugar, and rub the whole together with a spoon until the material is thoroughly broken up and mixed with the sugar. Then dissolve this thoroughly with three-quarters of a tumblerful of water which has previously been boiled and allowed to cool; float in this three or four pieces of cork which have been previously boiled and allowed to cool, then cover the tumbler with a piece of paper, and place it in a warm corner of the house, until the fungus is seen to be growing around the pieces of cork. A temperature of anything from 70 per cent. upwards will cause the fungus to develop in two or three days, the fungus is then ready for use.

To Distribute.

2nd. Make a hoop-net about 2 feet in diameter, of any gauze-like material, about 2 feet deep, with a handle attached. In this capture the locusts, and dip them into

the fungus contents of the tumbler, after a thorough immersion take them out, and liberate them ; repeat with more locusts, and so on until the glass or vessel has been emptied of its contents. Infect towards evening, and if possible when there has been, or there are indications of rain. Next, smear patches of grass where the locusts are feeding with the fungus, also capture quantities of locusts, and confine them in a box along with some of their favourite food which has previously been smeared with the fungus. Water fungus is not so effective in confinement as bread fungus. The bread fungus is more easily smeared over their food. Keep the box under conditions as near to the natural as possible, as locusts will die if too closely confined. In two or three days liberate the lot among a swarm, and repeat again.

To make Bread Fungus.

3rd. Take about one pound of white bread which is fairly stale, and then grate it into a coarse powder. Place a cupful into a basin, and add enough water to make a watery paste (water must be previously boiled and cooled),

ERRATUM.

At page 36, line 28, *instead of* " A temperature of anything from 70 per cent.," *read* "A temperature of anything from 70 degrees."

... has been given, if weather is dry carefully water the infected patches every evening until the fungus food has disappeared. Catch young locusts in net, and bring them to feed on the infected patches.

and let them go, and so on repeat until the glass is emptied of its fungus contents. The water must be cooled and boiled, also the corks. A tube of the fungus culture will make a copious growth on a basin of bread fungus in three days, and the fungus thus raised will make quite a quantity of water or other bread fungus. The bread is best for use when about four days old. Farmers can rely on this fungus disease as their friend, and should everywhere take up the work of extermination, which is not only useful but pleasurable.

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To make Bread Fungus.

3rd. Take about one pound of white bread which is fairly stale, and then grate it into a coarse powder. Place a cupful into a basin, and add enough water to make a watery paste (water must be previously boiled and cooled), add to this the contents of one tube of fungus, thoroughly mix with the paste (no sugar is required), place a covering over the basin if flies are numerous, and keep it in a warm place, same as for water fungus, and in two or three days the fungus will be seen growing over the surface of the paste ; it is now ready for use.

To Distribute.

4th. This is best used on locusts in the early or hopping stages, and distributed by placing small portions where the young locusts are feeding, and smearing the patches. If rain or heavy dews are prevalent the moisture thus received will keep the fungus growing until all has been eaten, if weather is dry carefully water the infected patches every evening until the fungus food has disappeared. Catch young locusts in net, and bring them to feed on the infected patches.

Remarks.

A tube of fungus will make a basin of bread fungus, and the fungus growth on the bread will make many glasses of water fungus, or basins of bread fungus. If the weather is moist at time of infection results should ensue in at least a week, if dry it may take three or even four weeks. For locusts in the flying or full-grown stages the water fungus is the proper treatment, and is also splendidly adapted to the hopping stage as well. Locusts die some distance away from place of infection, generally in a south-east direction. They turn a liver-colour when dead, and will be found along ditches, in grass, and depressions of the ground, in clusters and singly, depending whether swarms are large or small. The best results can be obtained by frequent infections in various places, as the insects are easily destroyed in the early stages.

PLATE XXXVIII.

THE "WHEAT APHIS" (*SIPHONOPHORA* SP.).

fig.

1. Wheat stalks and ear, showing blight. Natural size. From nature.
- 1A. Wheat stalks, full ear, showing blight. Natural size. From nature.
2. Winged viviparous female of Aphis. Magnified. From nature.
3. Pupa of above. Magnified. From nature.
4. Pupa of Aphis. Magnified. From nature.



W. H. H. Del.

French Direct

Sand & McLaughlin

CHAPTER XLIV.

THE WHEAT APHIS.

*(Siphonophora sp.)*Order : *Hemiptera*. Sub-order : *Homoptera*. Family : *Aphididæ*.

This pest of the farmer is one, perhaps, that gives more trouble than many of his other insect enemies. In appearance the fully grown insect is about the tenth of an inch long, with the body flattened and widest behind. (See Fig. II.) Each bears a pair of slender feelers (*antennae*), a jointed rostrum or beak, which is folded close against the under side of the body when not in use, three pairs of jointed legs, and towards the hind end of the abdomen are two short tubes (cornicles), the use of which are described in Part II., with open extremities. Colour, pale green, varying to brown and often black. A series of small spots, as shown in our figure, are ranged along each side of the abdomen. Regarding the life history of this pest but little is known here. It is, however, well known that the insects are particularly severe on cereals, as wheat, oats, barley, grass, &c., but is especially bad on wheat. According to the best authorities, this Aphid lives through the winter on the old roots in the ground, as do many of the insects of the same group. Professor Garman and others state that the common Wheat Aphid, *S. Avenae*, which is closely related if not identical with our own kind, lives on the roots and down in the ground on the stems of winter wheat, and that it also occurs through late summer and early fall on volunteer grain, these facts having been fully ascertained by American investigators ; but Mr. Bruner states that just where the true sexes, male and female, are matured, and where the

eggs are deposited that carry the insect through critical periods, is still a mystery. Wherever and in whatever manner the insect passes through winter, in spring it soon reappears upon the plants, where it develops quite rapidly by many generations, and spreads over the fields, the winged individuals establishing new colonies in distant localities. In America there are several parasitic enemies of the Corn Aphis, especially amongst the small *Hymenoptera*, and these creatures, two of the best of which being *Ceraphron triticum* and *Syrphus torvus*, the latter genus being seen in Victoria hovering about flowers, and often mistaken for bees. Professor Smith says it hovers about the wheat in the bright sunshine, and the female lays its long, oval, pure-white egg wherever she spies a colony of Aphids large enough to support the young larvæ when hatched. In Victoria the above parasites are not known to exist, but we have others, as the so-called "lace-wings," which are described in a former number of this book, also many minute *Hymenoptera*, both of which, no doubt, assist in keeping down the increase of this tiny pest.

Prevention and Remedies.

To practical farmers, the difficulties in the way of dealing with this pest where on large areas will be at once apparent, still something must be done, as a good crop where attacked by Aphids will soon be ruined, or next door to it, and it is no uncommon thing to find the crop badly infested, and all within a very short period, often in a few hours. (In a previous number of the book the cause of the extraordinary increases of the Aphidæ has been fully explained, so that it need not be repeated here.) As a preventive the use of certain artificial manures such as sulphate of iron, nitrate of soda, kainit, lime, &c., would appear to have a good effect. An analysis of the soil to be treated should be made, especially in the case of lime, so as to ascertain in what respect the soil is

deficient. Frequent fallowing, burning off stubble, scari-fying, and generally "knocking the land about," being about the best means to be adopted by growers. When the insects have made their appearance, the crop should be sprayed with either the "Strawsonizer" or some such machine, in which case kerosene emulsion as a spray would probably be the cheapest and best, the mixture to be made as follow:—Kerosene 2 gallons, soap $\frac{1}{2}$ lb. Boil the soap, and whilst boiling add the kerosene, churn violently for, say, ten minutes, then allow to cool, and to this add 30 gallons of water, which is strong enough for Aphids on corn. On large areas this treatment would, of course, be too costly, but on small holdings, where the crop was heavy, it would pay; and as this plan is adopted in Europe and elsewhere it should also answer here. In using the "Strawsonizer" or Pearson's sprayer (see Part II.) it would, of course, be necessary to lay out the land in such a manner that these large machines could pass along without damaging the standing crop. As a deterrent, tar-impregnated water, which is both cheap and effectual, on small areas, would no doubt produce excellent results. Professor Bruner states that there are ten other Aphids which attack corn, but, fortunately for our growers, these have not been observed in Victoria. Plate XXXVIII. shows the insects clustering around the stem and ears of wheat plants, also the insects highly magnified.

PLATE XXXIX.

APRICOT BEETLES (BELUS, FIVE SPECIES).

Fig.

1. Branch of Apricot showing damage done. Natural size. From nature.
2. Perfect Beetle (*Belus bidentatus*). Natural size. From nature.
3. Larva of Beetle. Natural size. From nature.
4. Pupa of Beetle. Natural size. From nature.
5. Perfect Insect (*Belus suturalis*). Natural size. From nature.
6. „ „ (*Belus sp.*). Natural size. From nature.
7. „ „ (*Belus irroratus*). Natural size. From nature.
8. „ „ (*Belus centralis*). Natural size. From nature.



CHAPTER XLV.

THE "APRICOT BEETLE."

*(Belus bidentatus, Donovan.)*Order : *Coleoptera*. Family : *Curculionide*.

We have now to deal with a most destructive pest, which, as shown in the plate, does great damage to apricot trees by boring and tunnelling into the wood, and thus killing the trees.

The genus *Belus*, five species of which are here figured, in their native state are usually found on young wattles (*Acacia dealbata*), and are easily shaken off into an expanded umbrella, the latter article being in constant use by the insect collector. These insects, the natural size and colours of which are given on our plate, first bores a hole with her snout, then deposits an egg into this hole, and finally pushes the egg to the bottom. In this genus it will be seen by the plate that the snout is much extended, and is highly favorable for the purpose of boring. The larvæ are soft, yellowish-white grubs without feet, and upon hatching from the egg at once commence to bore and tunnel, as shown on Figure I. In splitting off a portion of an infested stem or branch the insects may be found in nearly all stages of development, from the newly-hatched grub to the pupæ (see Fig. IV.) to the perfect insect, the pupa bearing a striking resemblance to the perfect beetle which is to follow. This is another illustration of our insects having forsaken their natural food for our introduced trees ; why we cannot say, unless it be that the latter plants are more to their liking. In this large family, which comprises many thousands of known

kinds, we have some of the very worst of our insect enemies, as the apple-root borer, plum-weevil, grain-weevil, and a host of others, and in tropical countries the large palm weevils (*Calandra*, &c.), do enormous damage to the native, also to the introduced vegetation. The genus *Belus*, at least so far as the Victorian species are concerned, are all timber feeders, and many of them assist materially in the destruction of many of our eucalypti or gum trees, and doubtless other trees as well. The beetles as given on our plate being absolutely life-like, so that there need be no difficulty in detecting them when seen, and as they are easily destroyed by crushing or immersion in scalding water it behoves all growers to be on the look-out, and to endeavour to destroy as many of the perfect insects as possible. It may be as well to explain that four of the figures as shown in the plate are included, so that orchardists and others may know that the whole genus are more or less destructive, and should always be destroyed when seen.

Prevention and Remedies.

In this case, as in most others of a similar kind, preventive measures are unboubtedly the best, as once the eggs are deposited, it becomes a matter of extreme difficulty to deal successfully with the trouble. There are many things, such as painting the trees with lime and sulphur mixed, spraying with kerosene emulsion and like materials, which may act as a deterrent to the female when about to deposit her eggs. A piece of old blanket spread under the trees (when in fruit) will, if the stem be tapped sharply with a cloth-enclosed mallet, be found most useful, as this will dislodge, not only these insects, but others of a destructive nature, the object of using the blanket being to enable those catching the beetles, say in bright sunny weather, as on calico or like material the insects can easily crawl out of the traps, whilst if flannel the small hook-like tarsi, or claws, become entangled, and their means of locomotion greatly retarded.

Should it so happen that in spite of the above precautions the female has succeeded in depositing her eggs, and the larvæ working in the wood, the best plan is to examine the trees carefully, and this is best accomplished by "running" a lens (a woolclasser's lens will do) over the tree, and when the affected limb is found cut it off and burn it at once. Do not deposit such on the wood-heap, as the larvæ will hatch out all the same, and the perfect insects will again be ready to carry on their depredations. The resin compound comes in handy in such cases as these, as by spraying with this material, the preparation of which is given in former numbers of the book, a "skin" is formed by which the holes are temporarily filled up, and this resin mixture is much disliked by insects generally. Too much care cannot be exercised in watching pests, especially of this kind, as once the eggs are deposited the difficulty of successfully dealing with them becomes more pronounced. Unfortunately for the grower, the attacks of such insects as these are most insidious, so it frequently happens that the mischief is partly done before the real cause of same is detected, constant vigilance being the price of success.

PLATE XL.

THE " TOMATO MOTH " (*HELIOTHRIS ARMIGERA*. HUBN)

Fig.

1. Tomato branch with larva in fruit. Natural size. From nature.
2. Perfect insect. Natural size. From nature.
3. Larva of same, dorsal view. Natural size. From nature.
4. Pupa, side view. Natural size. From nature.
5. Pupa, ventral view. Natural size. From nature.



CHAPTER XLVI.

THE TOMATO MOTH.

(*Heliothris armigera*, Hubn.)

Order : *Lepidoptera*. Family : *Noctuidæ*.

This moth, which is also known in America as the "Boll-worm," belongs to a group which for real destructiveness can hardly be surpassed.

The moth itself is the size of the one shown in Fig. II., but it varies also in colour, the larvæ, or caterpillar, especially so. The larva is either a greenish white or a dirty brown, with markings as hereafter described, and is widely distributed, being found nearly over the whole of Australia, also throughout Europe, Asia, Africa, and America. The eggs of this moth are deposited by the female in the spring, October and November in Victoria being the months in which the moths appear most plentiful upon the stalks and leaves of plants, also upon stubble, in haystacks, and elsewhere, and when hatched the larvæ commence to feed upon the surrounding plants. In the case of the tomato, it has been noticed that the eggs are deposited also on the leaves and stem, the young larvæ crawling up the stem and at once eating their way into the fruit (see Fig. I.), which they speedily destroy. When full grown, the larvæ descend into the soil, and just below the surface assume the pupa stage, from which they emerge as a perfect moth, the females of which at once commence to perpetuate their species, the egg-laying, to the number of from 40 to 60, and even more, being deposited in a very short time. There is scarcely any limit to the number of plants which this pest will

attack, as cereals, maize (especially), vines, garden plants, &c., are attacked in turn; and in America the losses sustained by growers through the ravages of these caterpillars are enormous. In Victoria, as well as in other countries, we have numerous other genera and species of Noctuidæ, many of which are pests of the worst kind. In New South Wales, the late Mr. Olliff tells us, there are usually three or four broods, which will account for these caterpillars being so frequently with us. Whole volumes have been published on this pest. As these moths are known here to produce more than one brood in a season, it will be hardly necessary to point to the advantage of dealing quickly and effectually with the early broods, as if these can be kept in check it would have a very desirable effect on subsequent hatchings. To those contemplating a search for the eggs and pupæ, it may be said that the former are a dirty yellowish white in colour, and in warm weather take but a few days to hatch out. The pupa (see Figs. III. and IV.) is of a rich brownish colour, and the size of those in the plate. Mr. Olliff says that the typical form is, perhaps, that in which the larvæ is longitudinally striped with white and dusky grey. In this form the following markings are commonly seen:—On each side of the body a broad lateral whitish stripe, extending from the head to the anal joint; above this a narrow dusky stripe, including a fine white line, and bordered on either side with four or five very delicate whitish lines. Each abdominal segment has eight dark spots or tubercles (see Fig. III. and on plant); many of the caterpillars are almost without markings. Frequently the fore wings exhibit no markings whatever, whilst many individuals have the typical markings (see Fig. II.) greatly exaggerated. These moths are also day flyers, and on a recent visit to the Fernshawe district of Victoria thousands of these moths were seen in a raspberry garden flying about in the strong sunlight, now and then alighting upon the leaves of the plants, but no egg-laying could be detected. In the economy and life history of

these moths there is yet much to be learned, but this would of course necessitate a close study of their habits in the field, our best teacher, and in this connexion I would be grateful for a record of any observations bearing on this important subject from persons living in the country, as by this means much valuable information might be obtained, which would be useful in assisting to combat this and other pests. As a rule, the Noctuidæ are either dusk or night flyers, and in such cases the eggs are likely deposited during these times. According to Professor Comstock, in his splendid book "The Study of Insects," there are more than 1,800 species of this group in North America, north of Mexico.

Prevention and Remedies.

As these caterpillars when in cornfields usually travel in the one direction, the trench with perpendicular sides will be found an admirable means of destroying immense numbers of this pest in caterpillar form, as they fall into the trenches and cannot crawl out again, and a man or boy, with a pair of wooden clogs or stout-soled boots, can in a very short time kill millions of them. When adopting the trench system, supposing the grubs are already in the crop, it must be so arranged that the trenches are placed as near together as possible, as the closer they are the better will be the results.

When these caterpillars are in orchards or gardens, spraying their food with Paris green—1 lb. Paris green, 6 lbs. lime, diluted with 160 to 180 gallons of water—is certain destruction to every caterpillar eating the leaves of plants so sprayed.

The excellent plan of laying poisoned baits has been tried here with the most perfect success, large areas of young vines having been saved by this means. Directions :—Take 50 lbs. of bran or pollard, 12 lbs. arsenic, 8 lbs. of molasses or treacle, mix well together, and lay pieces here and there throughout the crop. On large cereal

areas this plan would of course be well nigh impossible, but on small areas, and where valuable plants had to be protected, the system is perfect. In laying these pieces amongst the crop care should be taken so that children and domestic animals cannot have access to it, but where the poison is used as a spray only there cannot be, as I have previously shown in Part II., the slightest danger attached to its use. In the case of tomatoes and like tender plants spraying should be carried out with extra care, one of the largest growers of these plants in Victoria having on two occasions saved the whole of his plants and crop by adopting the so-called "bran and arsenic" plan as here described.

Birds, again, are most valuable helps to the grower, and although small birds, cuckoos excepted, will seldom tackle these caterpillars, turkeys, fowls, &c., will destroy immense numbers of them.

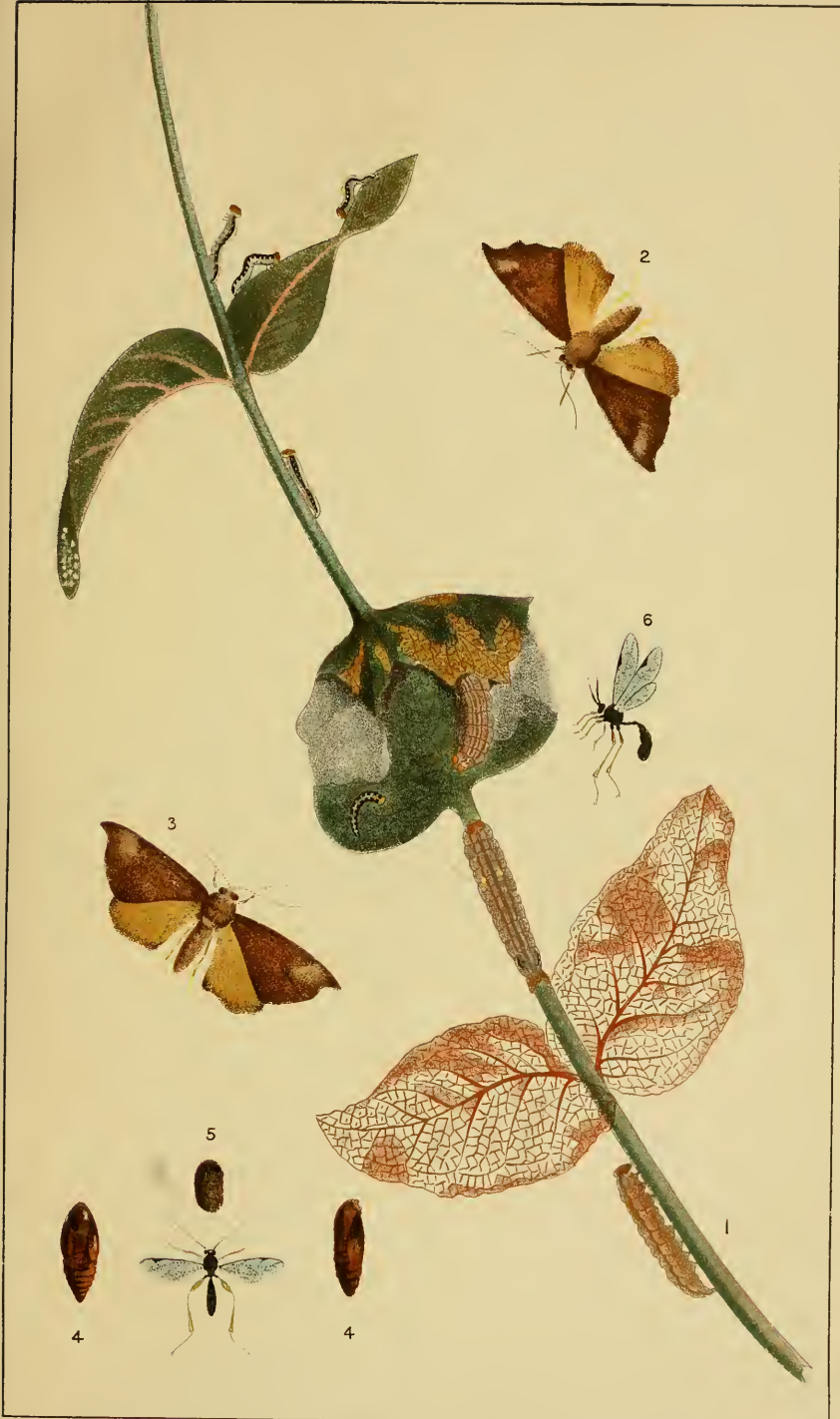
Catching the moths in nets made for the purpose is a good pastime for children, and by this means the number of egg-producing moths may be greatly lessened, thereby minimizing the evil for the coming season.

PLATE XLI.

THE "BLUE GUM MOTH" (*MNESAMPELA PRIVATA*, GN.)

Fig.

1. Branch of Blue Gum showing insect at work, various stages.
Natural size. From nature.
2. Perfect Insects. Natural size. From nature.
3. Perfect Insects. Natural size. From nature.
4. Pupæ, side and dorsal view. Natural size. From nature.
5. Cocoon and fly which attacks lava. Natural size. From nature
6. Side view of above fly. Natural size. From nature.



C.C. Brattlebank Del.

C. French. Pinxit
Plate XLI.

Troedel & Co. Lith.

CHAPTER XLVII.

THE BLUE GUM MOTH.

(*Mnesampela privata*, Gn.)

Order : *Lepidoptera*. Family : *Selidosemidæ*.

A brown moth, size and colour as per Figs. II. and III., the larvæ of which do great damage in our gum forests, more especially to young trees, the epidermis or surface of the leaves often being entirely skeletonized (see Fig. I.) which causes the leaves to die and fall off, and also destroys the shoots. In the vast forests which are here preserved by the State for economic purposes, the destruction caused by these grubs is enormous, as many as 50 having often been seen at work on one small branch. Upon referring to Fig I., it will be seen that these caterpillars have a singular habit of clustering together in a bunch, more especially when recently hatched from the eggs, and over which cluster a sort of film is placed, and under which the grubs are. As a rule, this moth is not very common, owing, it is supposed, to the grubs being attacked by some flies, either *Ichneumon* or allied genera, which destroys the caterpillars in great numbers. Many years ago it was almost impossible to find a gum sapling, especially those of *eucalyptus globulus* (blue gum), that were free from these pests, and as so many of our native insects have left their natural food in favour of the imported article, it was thought necessary to figure the insect under notice, so that should it make its appearance in our orchards, growers would not only be able to recognise it by the plate, but would also be the better prepared

to attack the pest from the outset. On the upper part of the gum branch in plate, the young larvæ may be seen in the act of feeding upon the leaves, and below, crawling up the stem, are the matured specimens.

Prevention and Remedies.

This pest being a leaf feeder is fortunately amenable to any treatment that will poison the food on which the larvæ feed, and for this purpose nothing is better than paris-green, prepared according to the directions given in our former chapter. In large forest areas, the spraying could not of course be carried out without great trouble and expense, but in avenues or in plantations every tree could either be rendered partly secure from the attacks of this grub, and supposing the caterpillars to be already at work, an occasional spraying with the above would promptly settle the matter. In addition to the poison, and as a preventive, the kerosene emulsion, or, better still, kerosene sprayed on by means of the "patent kerosene attachment," could be used with good effect. It may be said by some that the height of the trees would be against the success on large trees so treated, but on the continent; also in America, avenue trees of the height of 50 or 60 feet have been successfully treated by means of the powerful spraying machines (see appendices) in these countries. The necessity for the preservation and extension of our forests must be patent to all thinking persons, but once allow the growth of our young trees to be checked, either by insect attack or from other causes, forests of stunted timber will be the probable result. Figs. V. and VI. represent one of the flies which attacks the grubs of this moth with pupa of same.

PLATE XLII.

THE "VINE CURCULIO" (ORTHORRHINUS KLUGGI, SCH.)

Fig.

1. Branch of vine showing holes. Natural size. From nature.
2. Ditto ditto tunnels caused by larvæ. Natural size.
From nature.
3. Perfect insect. Magnified. From nature.
4. Ditto ditto. Natural size. From nature.
5. Ditto ditto, side view. Magnified. From nature.
6. Larva of same. Magnified. From nature.
7. Larva and pupa of same. Natural size. From nature.



7



4



CHAPTER XLVIII.

THE VINE CURCULIO.

(*Orthorrhinus Kluggi*, Schon).

Order : *Coleoptera*. Family : *Curculionidae*.

A couple of years ago cuttings of some insect-infested vines were sent to me by Mr. Molineaux, Secretary of the Agricultural Bureau, Adelaide, for examination and identification, and, after splitting open the cutting, as shown on Fig. II., I found the cutting to contain two white grubs as here shown, which had utterly destroyed the wood of the vine in question. Having placed the cuttings in the breeding cage, I was somewhat surprised to find, about twelve months after having placed them in the box, the perfect beetles emerging from the wood, and at once recognised them as the above-named beetle. It would appear that this pest is much more plentiful in New South Wales than in Victoria, as Mr. Froggatt mentions having received many complaints regarding the ravages of the same insects, and he further remarks that this beetle was fully described in a note read by the late Sir William McLeay, before the Linnean Society of New South Wales, as far back as 1883, giving an account of them having attacked vines in the Parramatta district ; also by the late Mr S. Olliff in 1894.

This small but pretty little beetle is slightly less than that shown in our Fig. IV., and is about $3\frac{1}{2}$ lines in length, of a reddish-brown colour with light markings (see Figs. III. and V.), which are of course highly magnified, the markings being somewhat fainter than is shown on our plate.

The larvæ is of a dirty whitish-brown colour, lightly covered with hairs, which we were unable to reproduce in the plate, and is about the size of those shown in cutting of vine, the one (see Fig. VI.) being magnified for the purpose of showing the mouth organs and segments of the body.

The pupa is of a very pale-brown colour, often nearly white (see Fig. VII., left-hand side), and, as will be noticed on the plate, partly assumes the form of the perfect insect.

Fig. I. illustrates the manner in which the grubs enter the vines, which seems always, or nearly always, to be below a joint in the wood. (We have not gone more fully into a description of the insect, as the plate shows this.)

In its native state this beetle feeds in the wattles, often on dead and dying wood, although it has frequently been cut out of wood which was perfectly green and healthy. Mr. Froggatt, however, has found that in New South Wales it prefers the timber when either dead or dying, and has fully described its habits and life history in the proceedings of the Linnean Society of New South Wales, 1894, Vol. IX., from specimens bred from the branches collected near Carlingford, New South Wales. According to Mr. Froggatt, who has had many opportunities of observing the habits of this pest, the beetles emerge early in summer and deposit their eggs upon the vines and orchard trees. After escaping from the egg the little grub eats its way down the cane or cutting, gnawing out the pith, as shown in Fig. II., and pupating at the end of its burrow, the perfect beetle emerging (in New South Wales) late in October.

Prevention and Remedies.

Here we have another of the but too numerous examples of an insect having forsaken its natural food for orchard and vineyard work. We have to deal with a pest which cannot be reached by poison or by contact, the larvæ being snugly ensconced in the wood of the tree

quite secure from the operations of spray pumps and other machines, save, perhaps, the gas tents, which might well be tried for the purpose. We have seen, too, that the grubs will remain for twelve months or more in the wood, which fact enables us to form some idea of the damage done during the twelve months of their larval existence. We have also to face the possibility of the larvæ tunnelling down the branches into the stem, and from thence into the roots, which would, of course, kill the plant attacked. So far, I have not heard of any stem or root attack, still the group are—many of them—most persistent borers, and thus we must be on our guard.

When in an orchard or vineyard the presence of this beetle is suspected the plants, where possible, should be shaken over an expanded umbrella. This would not, however, do when the fruit was present, as it would require a short and sharp shake or tap, as before described, to dislodge any beetles which were present for the purpose of laying. Fortunately, the holes being fairly large, the presence of these grubs, especially on vines, may be easily detected, and if found the affected parts should be removed and at once burned (not stacked), as the grubs, as I have before mentioned, will remain in the dead wood, and will come to perfection, only to again resume the work of egg laying. An occasional spraying with kerosene emulsion will frequently prevent the females of many insects depositing their eggs. It is to be hoped that this pest will not make much headway here, still we must be on the watch, as in the early stages of attack, much good may be done towards a mitigation of the trouble.

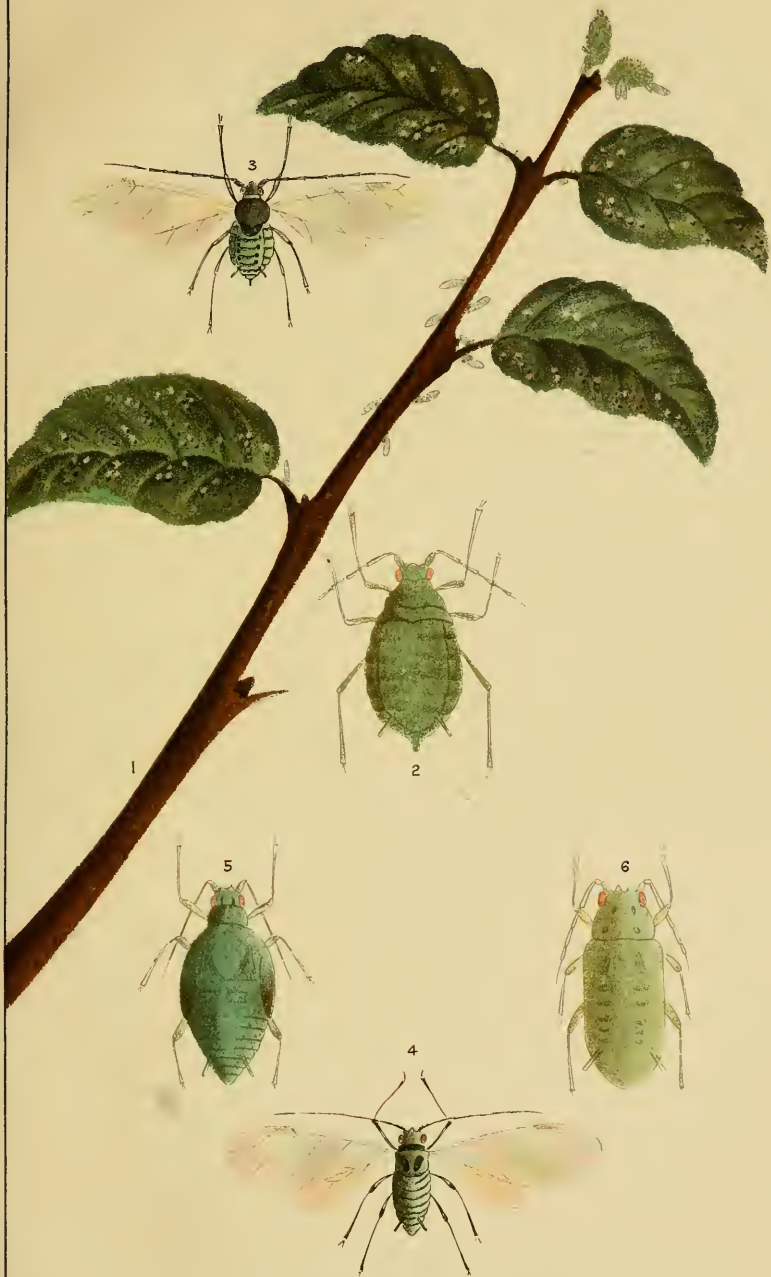
This little beetle has a wide range, having been found in Queensland, New South Wales, Victoria, and South Australia. There is another species (*Orthorrhinus cylindrostris*) which as a borer and general destroyer is far more to be dreaded than the smaller one under notice, and this species we hope to figure and describe in Part IV. of the present work.

PLATE XLIII.

THE "PLUM APHIS" (*MYZUS* SP.)

Fig.

1. Branch of Plum tree showing showing aphis on leaves and stem.
Natural size. From nature.
2. Larva of aphis. Magnified. From nature.
3. Winged female. Magnified. From nature.
4. Winged male. Magnified. From nature.
5. Larva. Magnified. From nature.
6. Larva. Magnified. From nature.



CHAPTER XLIX.

THE PLUM APHIS.

(*Myzus sp.*)

Order : *Hemiptera*. Sub-order : *Homoptera*. Family : *Aphididæ*.

This destructive little pest, which is well known to most orchardists as doing great injury to the tender shoots of plums of all kinds by sucking out the juices of the tree, thus causing the wood to turn black as if burned, is closely allied to the Peach Aphis, and near Melbourne usually makes its appearance about November.

In the plate we have endeavoured to convey to growers the almost exact colours and shape of the insects themselves, those on the twig of plum being slightly larger than the natural size, and on Fig. I. these pests are to be seen at work on the tree. On the plate (Fig. II.) is shown the larva of this aphid, and on Figs. III. and VI. are illustrated other larval forms, all of which drawings have been taken from the insects themselves.

The Plum Aphis then is one which should be dealt with promptly, as being in such vast numbers they soon cause great damage to the trees, and should be at once attended to, the young fruit growing on the portions of trees attacked frequently prematurely falling to the ground, and is therefore useless for the market. In the warmer parts of the colony this pest becomes most troublesome, but should a few hot winds set in the insects are killed, and disappear like magic. This remark will also apply to the Peach Aphis and many kindred insects.

Prevention and Remedies.

In early spring, and just before the buds commence to swell, lay bare the roots of the trees and spray the same with either kerosene emulsion, Bordeaux mixture, or both, adding a little spent gas lime as a covering (this should not be placed in direct contact with the roots). At pruning time thin out and burn as much wood as possible, then give the trees a couple of thorough sprayings with either kerosene (by means of the "attachment"), resin compound, or other materials before mentioned.

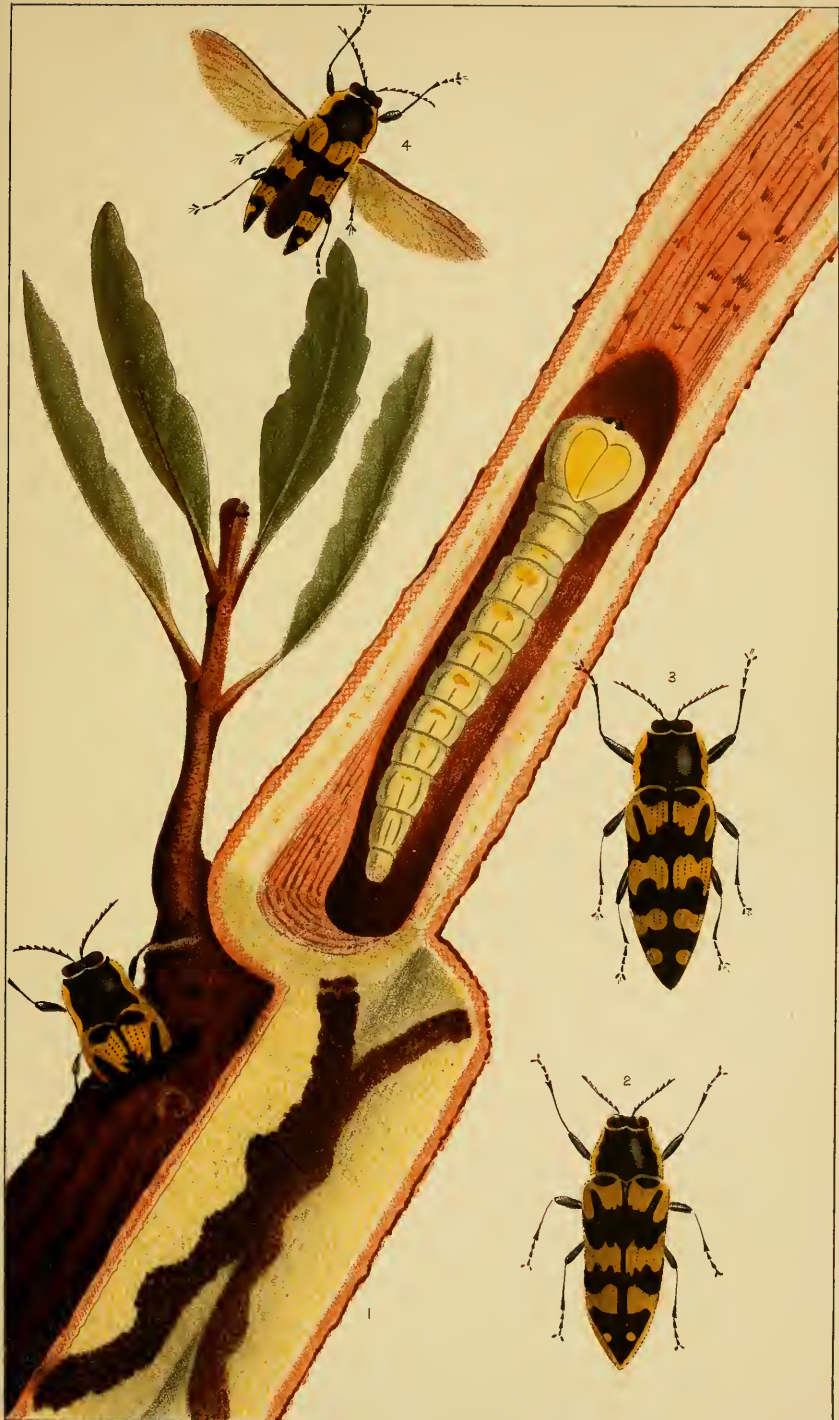
Should the aphids in spite of these precautions make their appearance, wait till the foliage has fairly hardened, then use the above, but in a more diluted form. Tobacco and soap is one of the good old remedies, and is especially useful when the foliage is tender—too tender, perhaps, to be able to use the more penetrating kerosene with safety. There are one or two other matters which are of importance, viz., the advisability of keeping your trees in vigorous health, *i.e.*, by first grafting your trees on the proper stocks. If you want to combat the pests keep the trees growing, keep the orchard clean, and see that it is properly cultivated. In Queensland the plum is also attacked by the "Fruit Fly," although according to Mr. Tryon this fly is not very partial to this fruit, but in Victoria, with the exception of the aphids and some small native weevils, it is comparatively free from insect attack.

PLATE XLIV.

THE "BANKSIA BORER" (*CYRIA IMPERIALIS*, DONOV.)

Fig.

1. Branch of Native Honeysuckle (*Banksia*) showing larva, tunnels and perfect beetles emerging. Natural size. From nature.
2. Perfect insect, male. Natural size. From nature.
3. Perfect insect, female. Natural size. From nature.
4. Perfect male, in flight. Natural size. From nature.



C.C. Brattle m.k. Del.

J. French, Linn.
Plate XLIV.

Truvel & Co. Lith.

CHAPTER L.

THE BANKSIA BORER.

(*Cyria imperialis*, *Donov.*)

Order : *Coleoptera*. Family : *Buprestidæ*.

This fine, but very destructive, beetle is chiefly to be found on and in the vicinity of our sea shores, the eggs being deposited by the female in the wood of the *Banksia integrifolia* or native honeysuckle, which trees form a broad belt of shelter along our coast lines. When hatched, the larvæ (see Fig. I.) commence to feed upon the wood of the tree, and tunnel into the tree (see Fig. I.), often destroying it altogether. The male (see Fig. IV.) is smaller than the female, but with the same bright, glossy, yellow and black colour, which renders this beetle very conspicuous, even at some distance. The female (see Figs. II. and III.) are, as a rule, rather more sluggish in their movements than are the males, both sexes being very wary, and take to flight quickly. The perfect beetle when emerging from the wood (see Fig. I.) is somewhat soft in texture, but a very slight exposure to the warm sunlight hardens the wing-cases and other parts of the insect, so that in a very short time they are able to fly with tolerable ease. In tunnelling the tree, the larvæ, which, together with the perfect insects are here given in their natural sizes, frequently bore down to a distance of from 8 to 10 inches below the surface of the soil, one having been found by the writer in the tap-root of a *Banksia* of small size. The larvæ of Buprestis beetles are most singular in appearance, the head part being wider and more flattened (see Fig. I.) than is the rest of the body, and tapers down as far as the anal segment as shown in

our plate. In New South Wales, and also on the coast, there occurs a black variety of this beetle, which however may prove to be a distinct species, as I learn from many good observers who have collected both kinds that the two always keep apart from each other and do not copulate as does the typical species. There are three other species known to entomologists, but these do not occur in Victoria. When the insect emerges from the wood in which the larvæ has been feeding (we do not know how long) it commences, as soon as possible, to fly on to the young Banksias, where on a very hot and still day these beetles may be seen perched upon the top points of the shoots with antennæ extended, the beetles being now very much on the alert, and the hotter the day the more difficult they are to capture.

Prevention and Remedies.

This insect, which with other kinds yet to be described in this book, bids fair to destroy the greater part of the Banksia trees, which together with the so-called "Tea tree" (*Leptospermum lævigatum*) line the sea shores from Brighton to the furthest end of the Victorian coastal line and on into New South Wales, and which trees are so valuable in assisting to protect the banks from sea encroachments, has, so far as we know, not yet attacked our introduced trees; but as many orchards are now being planted along and near the coast it will be well to be on the alert, as we never know when, as in many other instances, the insects will transfer their attentions to our orchards and gardens. The destruction, by any means whatever, of the fringe or belts of trees which line our sea shores is of very grave moment, and has not had the attention which such a serious matter deserves. If it be doubted whether such extensive inroads have actually taken, or are taking place, let any one walk from Brighton Beach to Mentone, and he will see for himself ample evidences of the vast inroads which during the last 30 or 40 years the sea has made. We must preserve these

natural belts of vegetation, and prevent, if possible, the destruction of the Tea tree, Banksias, Acacias, and other coastal plants, as in many ways few matters are of greater importance. Should this beetle be found in an orchard, capture it at once, as it may be there for the purpose of egg-laying; and as the holes made by them are fairly large, a wire, dipped in carbolic acid, creosote, or bisulphide of carbon, and pushed down to the bottom of the hole, or as far down it as possible, stopping the hole up at once, will usually kill any living thing which may be feeding inside. Another good plan is to obtain a small and pointed syringe, and with this inject carbolic acid, or, better still, carbon-bisulphide, closing up the hole with a piece of wet clay or any other close material which may be handy immediately, as this may be done effectually, and without the least injury to the tree so treated.

So far as we know, this beetle has but few natural enemies, excepting perhaps a few of the larger birds, the "Vocconia" spider, which will tackle insects of most kinds, and also some of the larger *Asilidæ*, a family of large dipterous or two-winged flies, which are veritable savages, subsisting almost entirely upon other insects, and even those of their own kind. This group, *Asilidæ*, are great destroyers of bees, and being furnished with a formidable trident-like proboscis, or beak, they can transfix their prey in the most secure manner. In the museum attached to the Entomologist's office is a specimen of a fully-developed *Cyria* beetle, with the *Asilus* fly fastened on to it by means of its proboscis, with which it had pinned the body of the beetle just in front of the scutellum, and when captured was trying in vain to fly away with its prey which it had already killed. It has also been noticed that many of these coastal beetles on hot days fly out to sea, and with a change of wind are blown into the water and drowned, their bodies being commonly found on the sand near or above high-water mark.

PLATE XLV.

THE "PHYTOMYZA LEAF TUNNELLER" (*PHYTOMYZA AFFINIS*).
Fig.

1. Leaf showing tunnels made by larvæ, with larvæ and pupæ.
Natural size. From nature.
2. Perfect insect, various positions. Magnified. From nature.
- 2A. Perfect insect. Natural size. From nature.
3. Larvæ of same. Magnified. From nature.
4. Pupa. Magnified. From nature.
5. Larva in section of leaf stem. Magnified. From nature.
6. Hymenopterous fly which attacks larva. Magnified. From nature.
- 6A. Hymenopterous fly which attacks larva. Natural size. From nature.



CHAPTER LI.

THE PHYTOMYZA LEAF TUNNELLER.

*(Phytomyza affinis.)*Order : *Diptera*. Family : *Muscidæ*.

An almost black minute two-winged fly (see Fig. II_A.), which does immense damage to vegetation, especially if of a succulent nature, by tunnelling or blistering the underside of the leaves of many plants as cabbage, turnips, cinerarias, and a host of other plants, especially those belonging to the Order Compositæ, many of which, as milk thistles (*Sonchus*), being veritable breeding grounds for swarms of this pest. The eggs are deposited on the leaves of the plant, and when hatched at once commence to make irregular galleries into the leaves, the larvæ, also the pupæ, being safely concealed under a kind of film or web, and from which the perfect insect may easily be reared by any one desirous of trying the experiment. In our plate is shown the blister-like tunnels on the underside of the leaf, also the larvæ and pupæ in their natural sizes, and on Fig. V. a section of the "blister" laid open, and showing a larva enclosed therein. Fig. II. shows the perfect insect, highly magnified, and in various positions. Figs. VI. and VI_A. represent a singular Hymenopterous (four-winged) fly, which works great havoc on this pest when in the larval and pupæ state, the specimens from which the illustrations have been taken having been reared from lettuce leaves gathered for the occasion.

Prevention and Remedies.

This pest is one of the most difficult of all insects to cope with, it being widely spread over the whole colony, but how it came from Europe is a subject about which, so far, very little is known. As a deterrent, however, spraying choice plants, from September to December, with weak kerosene emulsion or tobacco water, or in fact anything which would likely prove obnoxious to the insects and prevent them from settling on the plants for the purpose of egg-laying, would be advantageous. In spraying and otherwise treating for this pest (if the plants be in pots, dipping would be the easiest and best) be sure that the underside of the leaves are thoroughly treated, and weak solutions, on tender plants, especially those growing under glass, should always be used. This pest is a perfect terror to the gardener, as it not only renders his best plants unsightly, but not infrequently kills them outright. If, after all the precautions mentioned, the fly should attack the plants, which is not at all unlikely, all badly-affected leaves should be cut off and at once burned, and not fed to domestic animals as is often done. Smoking with tobacco is an excellent plan, also the use of the cyanide gas in an air-tight room, but with tender plants, at any rate, this latter should be used with great care, otherwise the remedy may prove as bad, or even worse, than the disease. In the present instance we have a pest which, although it may possibly be kept in check, cannot be totally eradicated, at least by artificial means, as, go where you will, it may be seen attacking thistles and many other kinds of soft-leaved weeds throughout nearly the whole of the colony, these weeds being simply breeding grounds for the pest, and from whence it is disseminated over the whole face of the country. To those who have plants affected by this fly, I may say, keep your places as clean of thistle, scape-weed, and other tender-leaved composites as possible. Pull up and destroy such plants of gazania, cornflower,

&c., as are affected, as the pest spreads rapidly when not carefully watched, which, when the plants are growing out-of-doors, is a most difficult task to perform.

To those who have plants growing under glass my advice is keep the tobacco smoke going as frequently as possible, and if one or two plants show signs of having been attacked by this little fly remove or destroy them if not valuable, then dipping must be resorted to, as the larva, being safely enclosed in the blister-like covering, is beyond the reach of poison, or even the ordinary preparations in use for leaf-feeding insects generally.

PLATE XLVI.

“CUT-WORM MOTHS” (*Mamestra Ewingi*, and *Agrotis* sp.).

Fig.

1. Portion of barley stem and ear with larva. Natural size. From nature.
- 1A. Portion of stem and ears of oats with larvæ attacking same. Natural size. From nature.
2. *Agrotis* sp. Natural size. From nature.
- 2A. *Mamestra Ewingi*. Natural size. From nature.
3. Larva of same beneath the soil. Natural size. From nature.
4. Perfect beetle, *Calosoma Schayeri*. Natural size. From nature.
- Pupa of Fig. II. Natural size. From nature.

CHAPTER LII.

CUT-WORM MOTHS.

(*Mamestra Ewingi*, and *Agrotis* sp.).

Order : *Lepidoptera*. Family : *Noctuidæ*.

The so-called "Cut-worm" moths are closely allied to *Heliothis armigera*, the one described in former pages of this book, the economy of all also being very similar, inasmuch as they are amongst the worst of all the farmer's insect enemies, coming as they do in such enormous numbers that crops of most kinds are simply ruined before there is time to gather the harvest in even for safety. In our plate, two kinds of these moths are shown, both having been drawn by Mr. Brittlebank from specimens which he found concealed in hundreds beneath an old haystack. Fig. II. is meant to represent a well-known and most destructive kind, *Mamestra Ewingii*, but in both figures the printing of the moths themselves is not so good as the original drawings were. Many of the *Noctuidæ* are very difficult to distinguish one from another, hence our difficulty on this occasion, the larvæ being almost alike, and the moths different, both having been found in the position as described.

When the caterpillars of these pests enter a field of crop, no matter whether it be wheat, barley, oats, or any other cereals, they attack it in such vast numbers that, if not checked, at least partial ruin speedily follows. These moths are diurnal as well as nocturnal flyers, and sometimes hide during the day amongst stones, rubbish, under

haystacks, and in many other places. When disturbed they do not fly far, but seem anxious to hide themselves from any strong sunlight. In speaking of some of the noctuid moths, Mr. Tryon says—"That in Queensland they usually select spots where the herbage is rank in which to deposit their eggs. We have found these on the introduced grass, *Bromus unioloides*. The eggs are placed between the two sides of the upper leaves of the plant before these are opened out, and are covered by, what is when fresh, a sticky substance secreted by the female insect. They are also laid in other situations both in concealment on the grass and about rubbish. In about a fortnight, probably less, when the weather is warm, the young caterpillars hatch out, and commence feeding immediately on the spot where they were born. They feed nearly always at night except when the weather is overcast or when they occur in swarms. When disturbed they immediately drop from where they were previously feeding, the young by a thread, the older ones without any. Having fallen, they quickly roll themselves up with the head inwards and remain motionless. After a minute or two they bestir themselves and soon crawl away. Should the plants on which they feed be isolated or offer little concealment they spend the day concealed in the nearest hiding place they can find, as under a stone or piece of wood. The caterpillar lives from two to three weeks, the duration of the moth in this stage being dependent upon the condition of the weather and the supply of food. This is the extent of its life during the summer months, but in the latitude of Brisbane many pass the winter without changing, hybernating under stones, &c. When about to transform into the chrysalis state the caterpillar burrows an inch or two into the ground, or crawls beneath a log or stone where it barely covers itself with earth, and in such a situation undergoes its metamorphosis. In three or four weeks after this, the moth emerges from the chrysalis. The number of generations during the summer months has not been

observed, but there are probably several. It has been noticed in America that, in the case of an allied insect, a species, too, of *Leucania*, each female moth lays from 500 to 700 eggs. It was noticed in the Brisbane district, in 1887, the caterpillars, the progeny of those grubs which had hybernated, were feeding early in September, and that the fully-grown insects were depositing their eggs from the 25th of September onwards. Caterpillars of these moths may be found in pastures throughout the year, but it is only when the winter has been mild, and has been succeeded by a spring favorable to vegetation, that the pests increase to such a numerical extent as to become noticeable. It is then, too, that they change their habits, and in quest of the larger supply of food which they then require, migrate, and, in order to get their share of it, feed by day as well as by night." Referring to one pest (*Agrotis spina*) or the so-called "Bugong Moth," so named from its having been found in countless numbers on some of the highest peaks of the Australian Alps.

In Vol. I., 1890, of the *Agricultural Gazette* of New South Wales, the late Mr. Olliff gives a most interesting account of the uses which these moths are put to by the natives of the Upper Tumut, New South Wales, and quoting Mr. Sharp, who was an eye witness to this singular aboriginal custom. Mr. Sharp says—"I made a trip in, I think, the summer of 1865, in company with Robert Vyner and two blackfellows, to the summit of one of the highest peaks of the Bugong Mountain (not Mount Kosciusko, but one of the same range of mountains), called by the native darkies 'Numbeyadang'; the peak adjoining it on the south is called 'Coonoondhrain,' and the one to the north 'Burrut-bind-yahlany.' These moths reside in the great fissures in the granite rocks, right on top of the peaks, and their numbers are as the sands on the sea shore. The moth is a dark yellowish-brown or brownish-yellow, about an inch long, and very plump and fat in the body, and when properly

cooked are very palatable and highly nutritious, judging from the condition of the birds that feed on them. The mode of cooking adopted by the blacks is primitive, but effective. Our two niggers provided themselves with bags, which were filled with bugongs by simply opening the bag and sweeping thousands of moths into it with their hands. These bags well filled were brought down to our camp at the foot of the mountain, a fire was made, and kept up with sticks which burn to a clear white ash, and, when a good heap of white ashes was prepared, a hole was raked in the heap with a stick, the moths tumbled in out of the bag, and the ashes heaped round them, and stirred about with the sticks for several minutes, and when the experienced cook reckoned the cooking was complete the mixture of the ashes and moths was well scattered about to cool and stop further cooking; when cool enough to handle, the moths' bodies—wings and legs pretty well singed off—were gathered up, ashes and all, and cleaned by simply pouring from one hand to another, and blowing on the falling mixture, by which means the moths' bodies were almost cleaned of ashes, and a little further delicate manipulation by gently rubbing the moths on the leg of the trousers completed the cleaning process, when the delicious moths were eagerly eaten."

With regard to the identity of the bugong with the species which has visited the coast district in immense numbers, Mr. Olliff says that he is in a position to state definitely that there is not a doubt on the subject. Specimens obtained at Mount Kosciusko agree in every respect with the moth which appeared in such vast numbers in Sydney and elsewhere in October, 1889, and with specimens obtained in 1867 during a similar visitation.

Prevention and Remedies.

In devising means for preventing the grubs of most of these common noctuid moths, the economy of which, as I have previously remarked, are often identical, from attacking plants, it must be remembered that the first step

to be taken is to render, if possible, the food obnoxious to the moths, this to prevent the egg-laying, and this can best be accomplished by the use of kerosene or other material, the nature of which, by reason of its oily substance and strong smell, would assist in keeping the moths away at least for a time. On small areas, this, by means of the powerful spray pumps now in use, would be a comparatively easy matter, the materials being both cheap, safe, and effectual. On large areas, such as corn-fields, &c., the trench system would appear to be the best. In Dr. C. V. Riley's able article on *Heliothis*, he says—"In those localities where the temperature falls low enough every winter to freeze the ground to the depth of 6 inches, late fall (autumn) ploughing will undoubtedly destroy most of the hibernating chrysalids. In our third report on the insects of Missouri we expressed the opinion that corn planted very late, and very early, and moderately late, the early crop being infested by the first brood, and the late by the second brood, in a bad worm year our rule would undoubtedly hold good; but in an ordinary season, if the corn is planted early and forced to early maturity, the ears will become hard before the second brood has made its appearance, the first brood not being sufficiently numerous to do any marked damage." (This advice, however, may not be altogether applicable here, at least, in the hotter and drier districts of the colony, as, in comparison, our climate is a semi-perpetual summer.) If the grass be not too dry, and there be no great danger of bush fires, lighting fires at night in the vicinity of the crop is a plan frequently adopted, as the moths, both sexes, are readily attracted by a strong light or blaze when they will fall into the fire, and in this manner enormous numbers may be destroyed (we have but to place a lamp near an open window to test this), always remembering that every female killed is probably the means of preventing an enormous egg-laying, and, under favorable circumstances, an increase of the pest. To prevent such caterpillars as

have not been reared within the cultivated area from entering the crop, the open trenches which should encircle the paddock should be about 18 inches wide by about the same depth, with perpendicular sides as before described. If found necessary to dig these trenches for the purpose of keeping the pest as much as possible in hand, the land should be so laid out as to admit of main trenches, with reticulations, throughout the field, which would have the effect of affording the means for the destruction of the greater number of the caterpillars which were in the crop. On grass lands where it is tolerably clear of trees, stumps, or stones, the brush-harrow will work wonders, as these are cheaply and easily made by bolting four pieces of strong hardwood quartering together so as to form a square, with a few saplings crossways across the frame, and into which rough branches, as mallee boughs, hakea, bull-oak, &c., &c., could be twisted, and with a fairly fast horse it is wonderful what can be done with these harrows in a day. During the past year, 1899, it was noticed by Mr. C. C. Brittlebank, who first brought the matter under notice, that the caterpillars in the Bacchus Marsh district were attacked by some disease which practically exterminated the caterpillars of these noctuid moths in this district, which is a large and important one, and where serious damage to the crops had previously occurred. Being desirous of obtaining some of the fungus-infected caterpillars, I sent my assistant, Mr. C. French, jun., to collect some specimens, and he reports as follows :—"Caterpillars attacked by the fungus were noticed on the slopes of the hills leading down to the Werribee River, at Myrniong, near Bacchus Marsh. The damage done by these caterpillars to the valuable native grasses, such as the 'Wallaby Grass' (*Danthonia*) and the 'Kangaroo Grass' (*Themeda*), &c., was very striking, large patches of ground appearing as if a mob of sheep had been camped thereon for some time, and having eaten all the grass and trampled stalks down it thus presented a very barren appearance. A few yards nearer the river

on a damp piece of ground were growing small clumps of a species of *Juncus*, the plants being from 1 to about 2 feet high, and on the tops of the stems the dead and dying caterpillars could be seen in thousands. They appear to crawl to the top of the stems of this plant, fasten themselves tightly on, and as the fungus starts generally (in some instances it might commence from the head) from the lower part of the body it gradually rots the caterpillar away, and, in numerous instances, pieces may be seen dropping off. Frequently I noticed the lower half of the caterpillar having fallen away, and the remaining part still alive. The caterpillar gradually rots away, the head and forelegs only remaining fastened to the plant. The caterpillars when attacked by the fungus have a sickly appearance, assuming a light-greyish colour outside, but the fluid in the body of the grubs from the effect of the fungus is of a dark greyish-green colour. This fungus must destroy the caterpillars rapidly, for on my visit to the spot where they were observed the first day, I collected fully 200 of them (more or less affected with the fungus), but on visiting the same locality the following morning for fresh specimens, the ones I had left on the previous day (probably about 150) were all dead, and their remains hanging to the tops of the plants. I examined the crops in the immediate vicinity, but could find no traces whatever of damage done to them by these 'Cut-worms,' the native grasses, as far as I could see, being the only plants affected. In the mallee, near Lake Albacutya, on one of the sheep stations a splendid patch (about a mile long by half-a-mile wide) of native pasture grasses was found in the same condition as at Myrniong, the caterpillars having practically destroyed every blade of grass, and on the dried stems countless numbers of the remains of dead caterpillars were observed."

We have here a pest which has hitherto caused an immense amount of damage to the farming, grazing, and dairying industry in Victoria and elsewhere, and although the study of such pests must necessarily be done in the

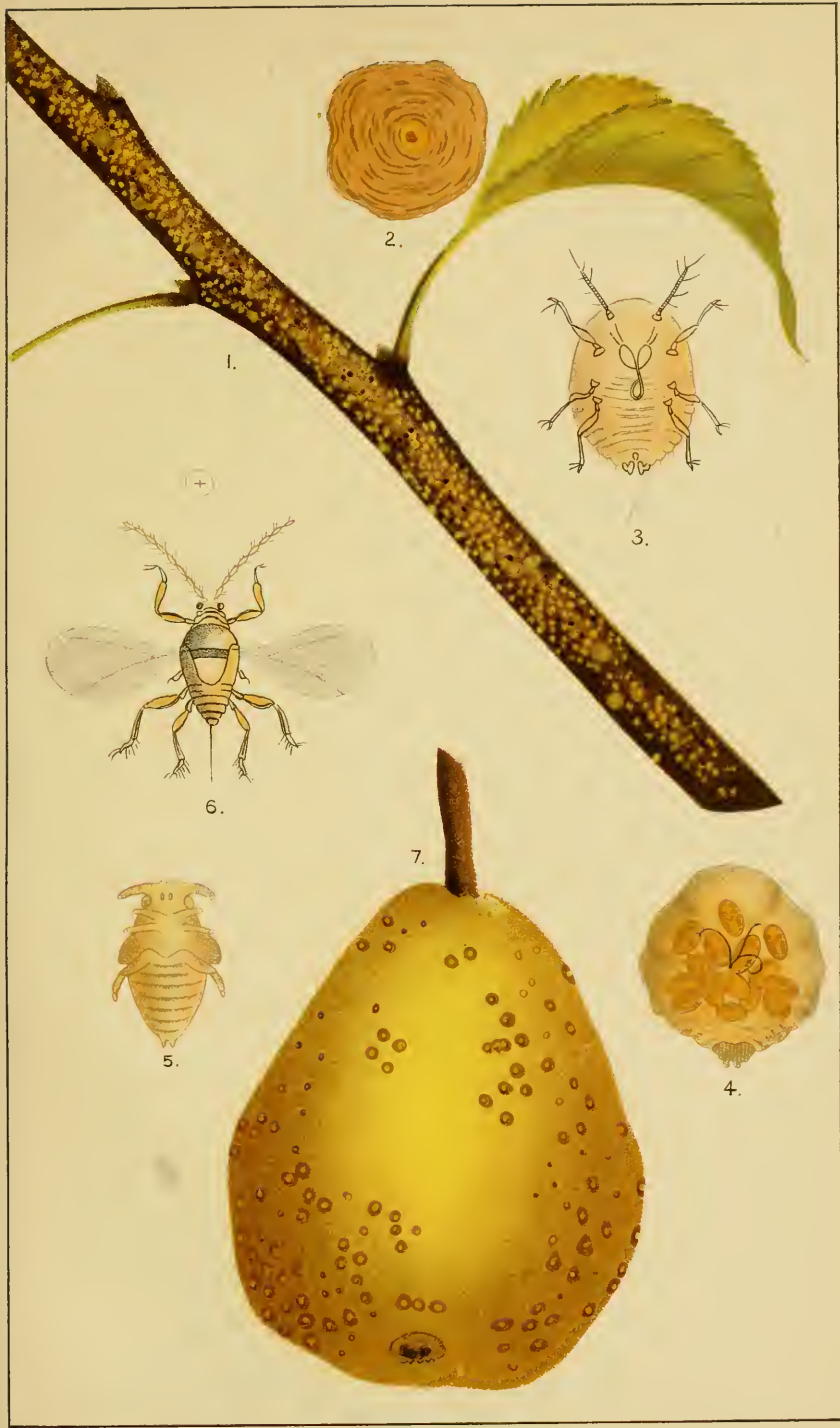
field, it behoves those interested to make all the observations possible, as only by a close study of the life history of these pests can we hope to successfully combat them. In a most interesting publication written and kindly sent to me by my good friend, Professor F. M. Webster (whom I had the pleasure of meeting when he was here), entitled *Vegetal Parasitism among Insects*, he gives a most lucid and exhaustive account of the success which, in America, has been achieved by the use of many of these parasitic fungi, which are designated as Entomogenous Fungi ; but, as these are not within my province, I must merely draw your attention to the work which is from the *Journal of the Columbus Horticultural Society*, April 1894, as being well worth much thoughtful study, showing as it does the great possibilities which may accrue by the introduction and practical uses of these fungi against our insect enemies. On Fig. IV. of our plate is shown a beetle (*Calosoma Schayeri*) which both in the larval and perfect stages is very destructive to grubs of many kinds, especially those which crawl on the ground. This beetle is commonly known as the "Saffron Beetle," owing to a fluid which it emits and which has a most pronounced saffron odour. It is a nocturnal insect, and on hot summer nights is attracted by the strong incandescent lights in the city and suburbs. In Europe, and in America also, there are several species of this genus which prey almost solely upon other insects, it being most voracious, *Calosoma sycophanta* being one of the largest as well as one of the most beautiful of the genus. Several wasps, Ichneumons, and other hymenopterous insects also destroy immense numbers of caterpillars, and it is an interesting sight to watch females of the larger Ichneumons probing with their ovipositors about the bark of trees in search of grubs in which they can deposit their eggs. As this is being written, a curious occurrence has attracted my notice, viz., in the dead body of a locust, which had been killed by the fungus introduced for the purpose of experiment and before alluded to, was found a caterpillar of

some noctuid moth which had partly buried itself in the body of the locust, and upon examination it was found that the inside of the latter had been nearly eaten out. Poisoned food appears to be a great remedy for these caterpillars when on small areas, as this work can be performed by boys and is both cheap and absolutely efficacious, but on large areas of course it would be well nigh impossible to make use of the poisoned food as before described.

PLATE XLVII.

THE "SAN JOSE SCALE" (*ASPIDIOTUS PERNICIOSUS*, COMSTOCK).
Fig.

1. Pear branch showing scale at work. Natural size. From nature.
2. Female scale. Magnified. New Jersey Board of Agriculture.
3. Scale, ventral view. Magnified. New Jersey Board of Agriculture.
4. Female and young. Magnified. New Jersey Board of Agriculture.
5. Larva. Magnified. New Jersey Board of Agriculture.
6. Perfect insect, male. Magnified. American publication.
7. Pear, showing scale. Natural size. American publication.



CHAPTER LIII.

THE SAN JOSE SCALE.

(*Aspidiotus perniciosus*, Comstock.)

Order : *Hemiptera*. Section : *Homoptera*. Family : *Coccidæ*.

This terribly destructive insect, which has recently been added to the proclaimed list of noxious insects under the provision of the Vegetation Diseases Act of Victoria, is, undoubtedly, one of the worst insect enemies with which our fruit-growers have to contend, and Professor Comstock, of the Entomological Department of the United States of America, has deservedly given it the name of the Perniciosus Scale.

In common with all the armoured scales, the life round of this insect, with the exception of a few hours of active larval existence, and an equally brief-winged existence in the case of the mature male, is passed under the protection of a waxy scale.

This scale covering conceals the real insect beneath, and prevents any easy observation or study of its life history. The winter in America is passed by the nearly full-grown insects under the protection of the scale. Early in April, in this latitude, America, the hybernating males emerge, and by the middle of May the overwintered females mature, and begin to give birth to a new generation, continuing to produce young and perish, the adult female giving birth to living young, differing in this respect from many other scale insects. Ordinarily, eggs are deposited beneath the scale, which, in the course of a longer or shorter time, hatch, and the young larvæ make their escape and migrate to different parts of the plant.

In the case of some scale insects the female fills its scale with eggs in the fall and perishes, the eggs wintering over and hatching the following spring. After being expelled the larvæ remain motionless for a little while, with antennæ and legs folded beneath the body. It soon hardens enough to run about, and, forcing its way out from beneath the protecting scale of the mother, scurries over the plant to find a suitable place to settle.

The newly-born larva (see Fig. V.) is an almost microscopic insect of pale-orange colour (our Fig. III. gives this as nearly as possible), with the customary six legs and two feelers, the long thread-like proboscis with which the juices of the plant are sucked up is doubled on itself, and lies in a part of the body wall, the tip only projecting.

The male and female scales are similar in size, colour, and shape until after the first moult, which occurs twelve days after the emergence of the larva. The mature male (see Fig. VI.) appears as a delicate two-winged fly-like insect, with long feelers and a single anal style projecting from the end of the body, orange in colour, with a faint dusky shade on the prothorax. In Washington four successive generations were regularly developed, with the possibility of a partial fifth generation.

In Australia, then, we have a large field for useful observation, as upon a careful study of the life history of these pests under changed conditions much depends as to whether we may be able to successfully cope with it or not, and in Part IV. any local observations will be carefully noted, and therein published for the information of growers, and any notes or observations bearing on the subject from those living in affected spots will be thankfully received and promptly acknowledged by the Entomological Branch of the Department of Agriculture. It may be remarked that as much of the above valuable information has been taken from the best and most up-to-date American publications the information contained is absolutely reliable.

In a most interesting and complete account of this insect Professor Howard, Chief Entomologist for the United States, in describing its importance from an economic point of view, says—"There is perhaps no insect capable of causing greater damage to fruit interests in the United States, or perhaps in the world, than the San Jose, or Perniciosus Scale. It is not striking in appearance, and might often remain unrecognised, or at least misunderstood, and yet so steadily and relentlessly does it spread over practically all deciduous fruit trees—trunk, limbs, foliage, and fruit—that it is only a question of two or three years before the death of the plant attacked is brought about, and the possibility of injury, which from experience with other scale insects of deciduous plants might be easily ignored, or thought insignificant, is soon amply demonstrated. Its importance from an economic stand-point is vastly increased by the ease with which it is distributed through the agency of nursery stock, and the marketing of fruit, and the extreme difficulty of exterminating it when once introduced, presenting as it does, in the last regard, difficulties not found with any other scale insect. The Los Angeles Commission reported, in 1890, that if this pest be not speedily destroyed it will utterly ruin the deciduous fruits of the Pacific coast. We are, therefore, justified in the assertion that no more serious menace to the deciduous fruit interests of the country has ever been known. There is no intention here to arouse unnecessary alarm, but merely to emphasize the importance of taking the utmost precautions to prevent its introduction into new localities, and to point out the extreme necessity of earnest effort to stamp it out where it has already gained a foothold."

This pest is, as far as we know, but a comparatively recent arrival in this colony, although it was reported on by the late Mr. Olliff as being in New South Wales as far back as 1892, as having been found upon pear trees in Maitland; and it has been proved beyond a doubt that the trees in the Wangaratta district, where the first outbreak

of this pest in Victoria occurred, came from an old and well-known firm of Sydney nurserymen, but from the long and honorable way in which their business has been conducted we are sure without their knowledge. When the first specimens of this pest were discovered in the Wangaratta district, I felt convinced that it was the dreaded San Jose Scale that was amongst us, so without loss of time I proceeded to that place and gave the necessary instructions for its suppression, and I am glad to say that my wishes have been responded to in a most intelligent manner.

It was thus hoped that the pest, which was not widely spread, had been stamped out, but in this we were mistaken, as recently another and a more serious outbreak has been reported from the same district, where every effort is being made for its eradication, and from personal inspection, coupled with reports received by the inspectors, this would appear to be in a fair way of being accomplished.

When this pest comes along, it comes, as our American friends say, to stay, and thus measures even if considered too severe must be promptly taken, it being better to sacrifice a few trees now than probably many in the future. When this scale attacks the fruit—pears, for example—a faint reddish spot, very minute, appears on the rind of the fruit; this gradually increases in size and intensity of colour, and with a glass the young scale may be distinctly seen fixed in nearly the centre of the diseased spot. This is an easy and certain method of detecting its presence on the fruit, and should always be remembered by growers.

From the Entomologist of New South Wales, and just as this is going to press, comes a very interesting and useful article on the subject of the San Jose Scale, and it is hoped that, with the well-known energy of the writer, Mr. Froggatt, this pest will be carefully watched in New South Wales, and no pains spared for its permanent eradication.

Prevention and Remedies.

As we in Australia have, fortunately perhaps, had so few opportunities of studying the life history of and dealing with such a formidable scale, we must be guided in a great measure by American experience, especially that of California, many parts of which closely resemble our own colony, and with a climate in many parts almost identical.

When the presence of this scale is ascertained, no time is to be lost, the badly-affected trees, if past redemption, must be grubbed out and carefully burned on the spot, or as near to it as possible, and the ground around where the trees grew thoroughly disinfected with bi-sulphide of carbon; this in the event of any of the scale having become detached from the tree during the operation of grubbing, as in operations of this kind one cannot be too particular. The old and slovenly method of cutting off diseased branches and stacking the same for firewood, and probable dissemination over the whole orchard cannot be too strongly condemned, as owing to the above-mentioned practice many such pests as mussel scale, &c., have been distributed over what before was probably a clean orchard.

Having made a careful search, in which a good lens will play an important part, cut away, if the season be at all favorable, as much of the branches as possible, ordinary pruning time being the best for the operation; then, with the aid of a good spray pump with kerosene attachment, continue the treatment at intervals until all traces of the insects have vanished, always remembering that when the tree is without its leaves the material used can be of a greater strength, the waste will be lessened, and the work done more cheaply and effectually.

The following are the principal methods of spraying as carried out by the American authorities, and may be safely relied upon; and although many things are

recommended by excellent authorities, I am quite in accord with the opinion of our greatest authority, the late Professor Riley, when he states that kerosene, if properly handled and administered, is the best of all insect destroyers. Of late years, however, the cyanide gas treatment has found great favour in America and elsewhere, where it is of great use, especially in nurseries and on trees of the citrus family. (I must refer you to Part I. for lengthy descriptions and illustrations of the tents used for this purpose.) But, so far as our own experience goes, we have found that kerosene will, if carefully used, do all which is necessary for the eradication of this or any other insects of a similar nature.

Mr. Froggatt has enumerated the before-mentioned American remedies, which are here reproduced from his articles :—

Winter Spraying.—(1) Kerosene Emulsion.

Kerosene, 2 gallons.

Whale-oil soap, $\frac{1}{2}$ lb.

Water, 1 gallon.

Dissolve the soap in boiling water, add the oil and mix thoroughly, using, if handy, a garden syringe for the purpose ; then add 3 gallons of water to each one of the emulsion, making 12 gallons of spraying mixture. Apply warm. Trees sprayed should be treated twice at least, as the young insects rapidly commence the work of reproduction.

Winter Spraying.—(2) Lime, Salt, and Sulphur Mixture.

Lime, 40 lbs., unslaked.

Sulphur, 20 lbs.

Coarse salt, 15 lbs.

Water, 40 gallons.

Take 10 lbs. of lime, 20 lbs. of sulphur, and boil until dissolved. Take the remainder of the lime and salt, slake,

and mix with the boiling mixture. (It would be better that all such preparations be made out-of-doors, or in some place detached from a dwelling.) Add more water up to 60 gallons, strain, and apply warm. Use gloves to keep the wash off the hands, and thoroughly clean and wash the spray pump after using this mixture. Do not use a copper vessel in which to boil this mixture.

Soap Wash.

Whale-oil soap and hard soap dissolved in hot water and applied warm:—

Whale-oil soap, $1\frac{1}{2}$ lbs.

Ordinary hard soap, $\frac{1}{2}$ lb.

Water, 1 gallon.

In addition to the above must be mentioned the resin compound, a most valuable and effectual wash for scale insects; also the hydrocyanic gas treatment, as practised by us at the Burnley Gardens, and before alluded to.

With regard to a fungus (*Sphærostilbe coccophila*, Tul.) which has been introduced from Florida into two orchards in scale-infested portions of the United States, Professor Smith, one of our best authorities on the subject, says—"In one of these two orchards it has become very well established. If it passes the winter successfully it may prove a useful means of reducing the scales to harmless numbers, and in such cases the disease should be distributed wherever the insects themselves occur."

In Victoria, as elsewhere, we have probably many minute flies, also beetles, which will attack this scale, as they do other kinds, still we who wish to stamp it out as soon as possible, must not put too much faith in natural checks but must keep the spray pumps going, and, as showing what can be done, Professor Smith says—"It has been proved beyond all doubt that whale or fish oil soap will kill the pernicious scale if applied at the rate of two pounds in the one gallon of water at any season, and half that strength will kill all that are hit by it in summer. The larvæ succumb to even weaker solutions."

To fight the San Jose Scale successfully, we must tackle it with a will, at once and continuously, as our climate, more than many parts of America, being warmer, is more conducive to the increase of such pests as this one, because we have a well-nigh perpetual summer, other conditions here being favorable to the active increase of insect life, all and sundry.

We hope, therefore, by increased vigilance over both trees and fruits, to be able to keep this pest within reasonable limits, if not to stamp it out altogether, which would, of course, be better. Growers are here reminded that the increase of this scale is very rapid, and Professor Howard tells us that in America this scale lives through the winter in the partly-grown condition, and in May resumes growth and becomes mature during the last week of that month, the young, as before remarked, being produced alive by the female, and at such a rate that in six weeks there will be between 450 and 500. In about a month the young are in turn ready to reproduce ; so by the time the old female dies the second generation is well under way, then continues until well along in December in some cases ; and a single female, starting in the spring, may become the ancestress before the end of the season of 1,160,000,000 scales, so we know with what a formidable foe we have to contend, and must take the strongest and most prompt measures at our disposal for its suppression. When this scale is discovered on the fruit, this should be gathered and at once destroyed by scalding, and not on any consideration must fruit so affected be allowed to go into circulation. Wherever the pest is found in a nursery, the latter should be at once placed in quarantine, there being a far greater danger in spreading this scale by means of trees than by fruit, as if the tree be affected you plant it out and by so doing establish the disease at once.

Growers are specially invited to act promptly, and should they suspect this pest to have entered their orchards, by immediately reporting the same, as only by

these means can we hope to eradicate such a dangerous menace to the fruit industry of Victoria.

When closing this chapter on this pest I have had brought under my notice the fact of a variety of this scale, which I have identified as the one named eucalypti, as having been found on bark of gum trees in the Wangaratta district. It is not yet known whether this variety will attack fruit trees, but this will, if possible, be ascertained, as if it should attack fruit trees the task of eradication will be rendered much more difficult.

For a further description of the cyanide gas treatment, see Appendices at end of this part of the book.

PLATE XLVIII.

THE "PAINTED APPLE MOTH" (*TEIA ANARTOIDES*, WALK.)

Fig.

1. Apple branch, showing larvæ in various stages. Natural size.
From nature.
- 2 and 3. Perfect insect, male. Natural size. From nature.
4. Perfect insect, female. Magnified. From nature.
5. Cocoon, eggs, and perfect insect, female. Natural size. From nature.
6. Perfect insect, female, dorsal view. Natural size. From nature.
- 7, 8, and 9. Pupa of male. Natural size. From nature.



CHAPTER LIV.

THE PAINTED APPLE MOTH.

(*Teia anartoides*, Walk.)Order : *Lepidoptera*. Family : *Liparidæ*.

This pretty little moth, which of late years has been doing great damage to many of our fruit trees, apples especially, by eating the epidermis, or surface of the leaves, is a native of the colony, and is another example of an insect having forsaken its natural food for the purpose of attacking our introduced fruit trees.

In a very able article written by Mr. Froggatt, in the *Agricultural Gazette* of New South Wales, November 1896, Part II., and bearing the title "Forest Moths that have become Orchard and Garden Pests," this moth and its depredations are treated in a very clear and exhaustive manner, and as the views and experiences of the writer agree exactly with those which have come under my own observation, I have given the greater portion of his remarks, as follows:—"The caterpillar of this handsome moth is one of the most destructive creatures to be found about Sydney, and is common all over New South Wales and Victoria. In its native state it feeds upon the foliage of many kinds of wattles, especially the Black Wattle (*Acacia decurrens*), but is now almost omnivorous in its habits. I have received specimens from Armidale, where the caterpillars have completely stripped cherry trees of their leaves in several orchards. In gardens around Sydney it has attacked the foliage of roses and pelargoniums. From Mr. H. G. Smith, of Tempe, I have received several branches of the Golden Wattle (*Acacia pycnantha*) swarming with these hairy little caterpillars, which had eaten off the upper part of the leaves, and

caused them to curl up and wither. In this instance the pests were fortunately attacked by a small parasitic wasp, a dainty little fellow, with long and slender black antennæ, slender-stalked body, fine gauzy wings, and bright yellow legs, belonging to the small ichneumon flies of the family *Braconidæ*.

It was evident that the wasps deposited their eggs upon the back of the caterpillars when the latter were very young, as before they were half-grown, the wasp larvæ had eaten up its host, and spun a stout silken cocoon covered with the skin of the caterpillar, and attached to the nearest twig.

Upon emerging from the egg the caterpillar is nearly black (see on stem of Fig. I. of our plate, which has been drawn from specimens reared in the office museum), but by the time they have grown a quarter of an inch in length they begin to assume a brownish tint, chiefly from a number of grey tubercles or warts appearing along the sides of the body.

They are now thickly clothed with long hairs, with two singular reddish-coloured appendages projecting from the back near the tail. (See Fig. I., on leaves of apple tree.) When full grown, the caterpillar measures about $1\frac{3}{4}$ inches in length, and is rather slender in shape, with the legs and claspers reddish yellow. The head is dull reddish brown, lightly covered with long greyish hairs, with a slender tuft projecting from each shoulder beyond the head, the tip of each of these long hairs forming a swollen lance-shaped point. Along the centre of the back from the centre of the first four abdominal segments there is a thick brush-like bunch of greyish brown hairs, the thoracic segments in front of these tufts being marked with yellow, and the whole of the upper surface of the caterpillar is covered with long brownish hairs, with patches of shorter grey hairs along the sides, a large projecting plume being formed on either side towards the tip of the abdomen. All these hairs are very finely feathered, which gives the caterpillar a downy appearance.

When full grown they crawl into any corner and spin a loose light-brown silken cocoon of a very flimsy character (see Plate XLVIII.), through which the pupæ can be plainly seen (see Fig. V.); and it will be noticed that more than half of them are fully twice the size of the others, the larger being the females. (See Fig. IV., which is magnified.)

In the summer time they do not remain in the pupal state longer than a fortnight, but in the winter broods not only do the larvæ feed much longer, but the pupal stage lasts until the summer months come round. The male moth (see Figs. II. and III.) measures about an inch (often less) across the outspread wings, of which the fore pair are dark brown (somewhat darker than those on our plate) marked with yellow and grey markings, with a black transverse band across the tip, and a patch of the same colour at the base of the wings. The hind wings are orange yellow in the centre, with a broad black band encircling them, fringed along the outer edge with yellow. The body is rather pointed towards the tip, whilst the thorax is stout, the antennæ short, broad, and beautifully feathered. When the moth is at rest it clings to the branch or wall with the wings pressed down on either side, forming an angle broadest at the base.

The female moth is a short rounded creature destitute of wings, with the antennæ and legs rudimentary, but thickly clothed all over with short brown down. Their life-work is very limited, as they simply crawl out of their shelter, lay their eggs (see plate) on top of it, and die.

The eggs are dull white, made brownish on our plate to suit the paper, hemispherical in shape, and showing fascetted structure under the lens. They are rather large for the size of the moth, and are generally matted together with the down from the moth's body.

Each female moth lays on an average about 700 eggs, so it is easily seen how rapidly a family of these moths can increase, especially as there are several broods in a year. (Figs. VII., VIII., IX. are intended to represent the

pupæ of these moths.) As this is such a singular insect, and the printing in our plate is in a few instances hardly correct in the colouring, it was thought necessary to give a fuller description of the insects than we have usually done.

Prevention and Remedies.

This pest, although it appears in such vast numbers as often to strip every leaf from a tree, and this in a very short time, may usually be prevented from laying its eggs by means of an occasional spraying with kerosene emulsion, or, better still, kerosene, used by means of the "attachment," as previously mentioned, and as the females especially are easily seen, these can be collected by hand and destroyed. In some countries, viz., in America, the larvæ of the Gypsy moth, which somewhat resemble the ones under notice, are trapped by placing a bandage known as the "Burlap," which somewhat resembles the bands commonly used in trapping the grubs of the codlin moth, but differing from the latter bands in being tied rather loosely round the middle, with the upper part partly folded down over the tie, and thus forming a more roomy trap than is required for the larvæ of the codlin moth. In Victoria, at least where the pest is, unfortunately, but too common, we can easily keep the caterpillars under control, the use of arsenites being all that is required, as in this case it is better to poison the grubs outright than to use measures for preventing the moths from depositing the eggs. The following, if done occasionally and properly, will kill any larvæ which feed upon the leaves. One pound Paris Green (paste form is the easiest to mix), 6 lbs. lime, slake, strain, and use the "milk," diluted with from 160 to 180 gallons of water, according to the nature of the trees to be treated. It must be borne in mind that the hairy nature of the grubs would probably prevent kerosene, or other materials which usually kill by contact, destroying these caterpillars, as it would not penetrate to the body of the insect,

and therefore poisoning the food is the most effectual method of dealing with these, no matter how great the numbers which are attacking the trees; and for the benefit of any person wishing to prepare this class of poison for the sake of cheapness, I give the formula as recommended by my colleague, Mr. A. N. Pearson, Government Agricultural Chemist for Victoria.

“In an earthenware jar dissolve $2\frac{1}{2}$ lbs. of sulphate of copper (bluestone) in 1 gallon of water. In another vessel dissolve 1 lb. of white arsenic (or $1\frac{1}{4}$ lbs. of crude arsenic from pyrites works) and 5 lbs. of common washing soda in 5 gallons of hot water, stirring occasionally until all the arsenic is dissolved. Keep the two solutions separate until required for use, then mix them in the proportion of one of the copper solution to five of the arsenic, and the resulting mixture, being diluted with from 45 to 60 times its quantity of water, is ready for the spray. Thus, the 1 gallon of bluestone solution and 5 gallons of arsenic solution, when mixed together, will produce 6 gallons of Paris Green mixture, which, being diluted, will produce 276 gallons of strong or 366 gallons of weak material for the spray.”

As a combination mixture for the purpose of spraying, Mr. McAlpine recommends the following, and says—“Either of the above forms (alluding to various forms of the Bordeaux mixture) can be used as a combined insecticide and fungicide with Paris Green or London Purple. The soluble arsenic in these substances is rendered insoluble by the action of the lime, and thus is not injurious to the green parts of plants. About 1 lb. of Paris Green added to 200 gallons of the Bordeaux mixture is found to be a safe combination.”

We have also other materials at our disposal, as hellebore, quassia chips, &c., &c., all of which have been alluded to in Part II., but in the case of the present insect the use of these is hardly necessary.

PLATE XLIX.

THE "CAPER BUTTERFLY" (*PIERIS TEUTONIA*, FABR.)

Fig.

1. Branch of Caper plant (*Capparis spinosa*) on which the larvæ of the butterfly are feeding, also chrysalid. Natural size. From nature.
2. Larva. Natural size. From nature.
3. Female chrysalid. Natural size. From nature.
4. Male butterfly on wing. Natural size. From nature.
5. Male butterfly in resting position. Natural size. From nature.
6. Female butterfly on wing. Natural size. From nature.



CHAPTER LV.

THE CAPER BUTTERFLY.

(*Pieris teutonia*, Fabr.)

Order : *Lepidoptera*. Sub-family : *Pierince*.

In certain seasons this is one of our commonest butterflies, while at other times it is comparatively rare. In that excellent little work, *Victorian Butterflies*, by Messrs. Anderson and Spry, the following description of this insect is given :—"White, with intensely black markings, the females (see Fig. VI.) having considerably more marking than the male, and both sexes in the summer brood having more black than the spring specimens. Some forms of the female have secondaries almost black, underside of primaries similar to upper surface, underside of secondaries with the veinings all broadly black, the base and the white spots in hind margin clouded with orange to a greater or lesser degree in some specimens quite suffused. This is the most typical and interesting species of our *Pierince*. As stated above, it varies very considerably, and the early collectors had the different forms in their collections under several names, the *Pieris Clytis*, of Donovan, said to occur in Victoria, was probably this species. Each brood has a wide range of variation, but, as mentioned, the summer brood is more particularly inclined to dark forms. It is very widely distributed, extending from the continent to New Guinea, the New Hebrides, Fiji, the Friendly Islands, &c., and when its strong migratory instinct is taken into account this is only what might be expected. As stated previously, it possesses this peculiar proclivity to a remarkable degree, in some years great numbers may be observed steadily

passing one after the other in the same direction, they never turn back, but fly on and on, urged thereto by that irresistible impulse which is so interesting and yet so perplexing to observers.

Although we at times have great flights distributed all over the colony, they are generally fairly broken up and scattered, and rarely, if ever, do we see the vast flights, such as have been observed in Queensland, passing at a great altitude from east to west.

The eggs are very pretty objects, being a pale-yellow colour, shaped something like ninepins, finely ribbed, and deposited upright in patches of 50 or 60 upon the upper surface of the leaf.

The caterpillars will attack any species of Caper (*Capparis*). *C. nobilis*, *C. lasiantha*, and *C. Mitchelli* have all been given as food plants from New South Wales and Queensland, but only the latter species is indigenous to this colony, and that only in the northern part. By reason of their great numbers these caterpillars frequently strip the Caper trees (see Fig. I., on which the full-grown caterpillar and chrysalid is shown), the tops especially being rendered quite bare, and signifying the presence of the larvæ even from a distance. The full-grown caterpillar is cylindrical, slightly tapering at each end ; head black, with scattered hairs and a white V on face. The dorsal area is dark olive brown, covered with very small yellow dots, and with a series of larger spots on each segment ; spiracular lines, yellowish ; ventral area, yellowish green. Some eggs obtained by the authors were deposited upon 19th November, and hatched upon the 29th, the larvæ made good progress and were all changing into the chrysalis state on 29th December, or exactly one month from date of hatching, the perfect insects emerged about 11th and 12th January.

The chrysalis is pointed in front, and is greyish white, speckled with black and yellow. (Our figure has been drawn from a very dark-coloured specimen, on which pink was prominent.) The insects mostly emerge between

dusk and dawn, a somewhat unusual time. The butterfly is on the wing throughout the summer months, but the main body appear in November, and again in January and February." With regard to the flights of these butterflies, as above alluded to, it may be mentioned that in parts of South Queensland clouds which took the whole day in passing a given point have frequently been noticed, thus indicating the enormous numbers which at the one time must be on the wing. In Queensland there are no less than sixteen species of the genus *Capparis*, thus it may be easily surmised that the natural food-plants of these caterpillars are ample for all purposes.

Prevention and Remedies.

Capparis spinosa, the Caper of commerce, will, if left alone by the caterpillars, thrive well near Melbourne, and in many other parts of the colony probably it will do better. About 25 years since the late Baron von Mueller, who was always to the fore in his endeavours to introduce plants of economic value, imported a number of plants of the common Caper. These plants made admirable growth, and were thriving splendidly, with the promise of a fair crop, when one morning I discovered that the plants, every one of them, had been quite stripped of their leaves, and in many cases of their leaf-stalks and fruit-stalks too, and, upon examining the plants, I found swarms of the fully-gorged caterpillars, some still adhering to the plants, whilst others had dropped off, and were crawling about the ground in the near vicinity of the plants. The matter was reported to the Baron, who at this time was Director of the Botanic Gardens, and I will never forget his chagrin over the partial destruction of his favorite plants, which he had frequently tended with his own hands. At this time there were no spray pumps in Victoria, or, I may say, in Australia, so we had to be content with using an ordinary garden syringe and a mixture of soapsuds; Paris Green, London Purple, and the like being at this time quite unknown here, at least as a material

for spraying. The soapsuds treatment acted fairly well, as it left a sedimentary deposit upon the leaves which certainly had not the effect of attracting the female to the plant for the purpose of egg-laying. The eggs were deposited, before the remnants of the plants had been treated, in great numbers, the young larvæ when hatched crawling over the plants and eating voraciously. This butterfly is easily reared by either feeding the larvæ or from the chrysalis, the latter method of course giving the least trouble.

It is thought by many entomologists that this insect does not confine itself altogether to the *Capparis* for food, but, so far, we in Victoria, have not heard of a case in which it has attacked ordinary fruit-trees. In Europe the caterpillar of an allied butterfly (*Pontia rapi*) commits great havoc to such plants as cabbage, turnips, &c., and as it deposits its eggs on the under side of the leaves it is less amenable to successful treatment than are many other pests which deposit the eggs on the upper surface of the leaves or stem. In treating trees for these caterpillars the arsenites should be used, although in the old country, so far back as 1860, Hellebore, as a powder dusted on and under the leaves, gave good results. When insects such as these have to be dealt with good work may be done by means of catching the butterflies in a net and destroying them, also by bruising the eggs with one's finger, and by collecting and destroying the chrysalids, which latter are easily seen, as much of this work could be done by children. It is probable, too, that this butterfly, when in the larval and chrysalid stages, especially in the latter, are attacked by Ichneumon flies, as I have found many of these chrysalids which had been punctured by some insect, which thus assists in keeping down the numbers of this pest.

PLATE L.

THE "WATTLE GOAT MOTH" (*ZEUZERA EUCALYPTI*, BOISD.)
Fig.

1. Perfect female on wing. Natural size. From nature.
2. Perfect female on wing, side view, resting. Natural size. From nature.
3. Larva and protruding pupa-case in branch of Wattle *Acacia dealbata*. Natural size. From nature.
- 4.
5. Pupa. Natural size. From nature.
6. Pupa-case from which the moth has escaped. Natural size. From nature.



5





CHAPTER LVI.

THE WATTLE GOAT MOTH.

(*Zeuzera Eucalypti*, Boisd.)Order : *Lepidoptera*. Family : *Zeuzeridæ*.

This large and very handsome moth is, unfortunately for our timber supply, very common, although perfect specimens, by reason of their being much torn during flight, are difficult to obtain. The eggs of this moth are deposited mostly in crevices of the bark of the thicker branches of the wattle (*Acacia decurrens*), and, when hatched, the young larvæ commence to feed, and, head downwards, work into the interior of the tree attacked, enlarging the cylindrical tunnel as they grow, and eat their way downwards, often, as the late Professor McCoy states, reaching to the roots. When young the larvæ are of a pinkish colour, but as they develop the grub changes to a more yellowish colour, and so remains until it is about to assume the pupa state (see Fig. III.), the larva is noticeable by the very singular shield-like and horny plate on the back of the head, as shown in our plate. The mandibles are short, stout, and of considerable strength, which enable the grub to gnaw the wood, no matter how hard, with great rapidity. When about to change into the pupa state it forms, as Professor McCoy also tells us, a slight cylindrical cocoon from 4 inches to a foot long of silk, and sawdust-like grains of wood as a lining to the end of its burrow. (This process may easily be seen by any one interested.) When the burrow terminates in a root, which not unfrequently happens a few inches below the surface of the ground, the cocoon is continued from the hole in the wood upwards

as far as close to the surface of the ground ; but when the burrow is in the surface of the trunk of the tree above the ground level there is no prolongation of the cocoon. In either case the pupa works itself forward by means of the little deflected spines on the rings, pushing for half-an-inch or so through the end of the cocoon before it bursts to allow the perfect insect to escape. The ovipositor, which is shown on Professor McCoy's beautiful plate (see *Prodromus*, page 47), is of great length and rigidity, equalling half the length of the abdomen when fully exerted, but capable of being retracted out of sight ; with this the eggs are deposited deep in the crevices of the bark of the trees, on the inner timber of which the larvæ feed. The caterpillars of this moth are great feeders, and when we consider that these frequently remain in the wood for two or even three years, we are able to form some idea as to the enormous damage done by them to some of the most important of our timber trees.

The perfect insects (see Figs. I. and II.) are very beautiful, the male being much smaller than the female, the former having pectinated feathery antennæ, which as our figure shows does not occur in the female. These moths are nocturnal in their habits, and in the late afternoons on hot summer days, January and February, may be seen emerging from the pupa-case and ascending the trees, where the wings harden, and in a few hours are able to fly for a short distance. When kept in confinement they will frequently deposit an enormous number of eggs, which are small and pale in colour. It has been often wondered how it happens that these moths are not more plentiful than they really are, but in my opinion the problem is by no means difficult to solve, as in the first place but a small percentage of the caterpillars come to perfection, and, in the second place, it so happens that on emerging from the pupa the moth is not sufficiently strong to ascend the tree, they then become an easy prey to the numerous ants who are always on the watch for such an event to happen. It is

interesting to watch these tiny creatures attacking a moth which is incapable of flight ; they commence by biting off the tarsi or feet, then the antennæ and points of the wings, and when the unfortunate moth is quite disabled and helpless commence to explore its interior which they eat out whilst the poor insect is still living. It is unfortunate that this moth should have a most inappropriate specific name as it does not attack eucalypti or gum trees, but feeds almost entirely on the wood of the black wattle (*A. decurrens*), which, as is well known, is one of the most valuable of our barks for tannin purposes.

Prevention and Remedies.

As showing the necessity for endeavouring to keep this serious pest within reasonable bounds, I cannot do better than again quote from the *Prodromus* in which Professor McCoy says—"Considering the great importance attached lately by the Government to the preservation and cultivation of the wattle or acacia trees, and the great and increasing annual money value of the bark, it is important for bark-strippers and the persons employed by the Government to foster the growth of the wattles to know the appearance of the insect reproduced on our plate as the greatest destroyer of these trees, so that attention may be given to killing the perfect moth ; the large abdomen of which is distended with millions of eggs, each of which may produce a voracious grub as thick as the thumb and 5 or 6 inches long, eating the timber for years."

The best time to examine these trees when in a plantation is when the tree is young, and if the holes are detected the larvæ may be reached with a piece of wire dipped in carbolic acid, and thrust as far down the hole as possible. It is very doubtful whether in this case spraying would be of much use, the best plan I have yet seen for the destruction of caterpillars in the interior of the tree is undoubtedly that of hot steam projected with great force by means of a small portable engine, and this process

might, with advantage, be tried so as to prevent the egg-laying. I can with confidence recommend the steam sprayer for grubs in avenue trees, as elms, &c., as when the steam is applied, the chemicals being ejected in vapour form, the grubs will very soon be seen tumbling out of the holes in the tree ; that is when they have sufficient strength to do so, as it often happens that by a direct application the grubs are killed outright. This large moth has, so far as I am aware, not yet attacked fruit trees ; that it may do so is quite within the bounds of possibility, and whilst recognising the fruit industry as one of the greatest importance, it must not be forgotten that there are other industries which require information such as the present we trust will afford, so that allusion to these timber-feeding insects, following the procedure of similar works published in America and elsewhere, are in my opinion fully justified. When one comes to examine the wattles grown for bark, and particularly the older specimens of which there are now unfortunately very few to be seen near Melbourne, it will be found that the great majority of these useful trees are hopelessly damaged, chiefly owing to the ravages of the insects in question, it being well known to field entomologists that there are few other trees which contain so many internal depredators, which when taking into consideration the bitter and astringent nature of this tree is most extraordinary. The wattle grubs have, as a rule, very few parasitic enemies, although after having died as often happens in the wood, the bodies will be found to be enveloped in a white leather looking fungus ; but which, so far as my observations lead me to suppose, occur only after death. In New South Wales and Queensland are some huge moths of this genus, one *Z. Macleayi* being nearly 9 inches across the wings ; the beautiful *Leto Staceyi* being still larger ; both doing immense damage to the Eucalyptus inside of which they feed. It may be mentioned that in the early days of the colony, and when wattles around Melbourne were plentiful, the larvæ of

these moths were eagerly hunted for and eaten by the aborigines, also by fishermen who sought them for baits in fresh-water fishing, and by these and by probably other means known to the early colonists, these pests were greatly reduced in numbers.

In concluding this chapter it may be mentioned that the posing of the figures on our plate have been mostly adapted from the *Prodromus*, the colouring being life-like, the drawings having been made by our artist, whose name appears in the corner of each plate, from specimens taken by myself, and which are now in the office collection.

PLATE LI.

THE "GUM EMPEROR MOTH" (*ANTHEREA EUCALYPTI*, SCOTT).
Fig.

- 1 & 1A. Perfect insects (males). Natural size. From nature.
2. Perfect insects (female). Natural size. From nature.
3. Larva on gum branch, also eggs. Natural size. From nature.
4. Cocoon. Natural size. From nature.





CHAPTER LVII.

THE GUM EMPEROR MOTH.

(*Antherea eucalypti*, Scott.)

Order : *Lepidoptera*. Family : *Saturniæ*.

This beautiful insect is, with five exceptions, viz., *Chelepteryx Collesi*, *Cæquosia triangularis*, *Antherea Helena*, *Zeuzera eucalypti*, and *Pielus*, the largest moth in Victoria, it being the size and colour of those figured in our plate. The larva of this moth when just hatched is nearly black, but as it grows larger it becomes green, and when fully developed green, each segment being adorned with tuft-like projections of a beautiful orange and blue colour, bearing some resemblance, as Mr. E. Anderson in his valuable paper remarks, to a sea anemone. The eggs, which are yellowish white (see those on the leaf in our plate), are laid in rows on the upper surface of the leaf, and the young caterpillars at once commence feeding on the leaves of the tree. As these little creatures increase in size they become very voracious, and will strip the leaves from a gum sapling in a very short time. The pupa-case is of a hard woody nature, and from which the moth cuts its way out of the cocoon, a process which takes some considerable time, and may be plainly heard during the operation. These woody pupa-cases, one of which is shown on the plate, are firmly attached to small twigs of the branches of the tree, but sometimes on fences and elsewhere, and even when detached the perfect insect is easily reared.

The males of this moth have beautiful antennæ or feelers (see Figs. I. and IA.), those of the females being plain (see Fig. II.), the moth itself being of a

delicate reddish-fawn colour, but variable in both size and colour, often with a pink tint and four eye-like spots or blotches, two on the upper wings, and two, and much more beautiful ones, on the lower wings, as shown on plate. This insect is nocturnal in its habits, and may often be taken whilst flying around the street lamps by the light of which it has been attracted, but in such cases the specimens are mostly battered and otherwise torn. When the perfect insect emerges from the cocoon, which by the way is a very singular process, and which Mr. Anderson has well described, is somewhat crimped, but the wings soon harden and become firm, the males, according to my observations, and I have reared many of both sexes, predominating. This is not an uncommon species, the second Victorian kind, *A. Helena*, being comparatively rare, and is usually found in mountainous districts or near to them. Fig. I. shows a branch of one of the eucalypts or gum trees, *E. viminalis*, stunted specimens of which are to be found growing in the reserves around Melbourne, also the caterpillar and pupa on same.

Prevention and Remedies.

This fine insect is included in Part III., as of late years it has almost forsaken its natural food, and is now attacking the pepper trees (*Schinus molle*), which, for planting in hot dry districts, is one of the most valuable for avenues or street decoration, and if allowed to remain on the tree will speedily ruin it, no matter how healthy and vigorous the plant may be. Fortunately, however, it is easily got rid of, and an occasional spraying with kerosene emulsion will usually prevent the female depositing her eggs. When trees are attacked, spray with Paris Green prepared as before mentioned, as when the food plants are poisoned by this means the caterpillars survive but a very short time, and having partaken of the poison at once cease eating, curl up, drop from the leaves, and die. It has not yet been



C. C. Britt, bank, Del.

C. French, Direct

P. A. Ashby, Lith.

known, I believe, to have attacked fruit trees, but as it has left its natural food for that of a pungent-flavoured tree such as the pepper tree undoubtedly it is hardly likely to be particular in its choice of food. On small trees hand-picking may be carried out with good results, the caterpillar being, even when only partly grown, both large and showy, and is thus easily detected. On the leaves of the pepper tree the eggs are deposited in exactly the same manner as on gum leaves, with this exception, that the leaves of the pepper tree being narrower the eggs are deposited close together. In classifying the Lepidoptera most people are aware that these are divided into two sections, viz., Rhopalocera (butterflies) and Heterocera (moths), so that further allusion on the chapter page will be unnecessary. It is gratifying, however, to know that the larva of this moth has many insect enemies, notably Ichneumons, Braconids, also minute Hymenoptera, specimens of which may be seen in the Museum of Economic Entomology attached to the office of the Government Entomologist.

PLATE LII.

THE "GUM SAW FLY" (*PERGA DORSALIS*, LEACH).

Fig.

1. Gum branch, showing cluster of larvæ. Natural size. From nature.
2. Cluster of cocoons, side and upper view. Reduced. From nature.
3. Perfect insect. Natural size. From nature.
4. Perfect insect. Natural size. From nature.
5. "Saw" of female. Magnified. From nature.
- 6 & 7. Larva and pupa of Dipterous fly which attacks cocoons of this insect. Reduced. From nature.

CHAPTER LVIII.

THE GUM SAW FLY.

(*Perga dorsalis*, Leach.)

Order : *Hymenoptera*. Family : *Tenthridinidæ*.

This insect, which is the largest and most common of our Victorian saw flies, will no doubt be familiar to all who either live in or travel in the bush by the singular larvæ which will be found huddled together on leaves of young gums, which they rapidly destroy. The larvæ, as many as twenty or more, may be found both on the upper and underside of the leaves, also on the upper part of stem of the saplings, upon which they feed, arranged for the most part in regular rows. When disturbed, and especially if touched, they bend their bodies in the form of an arch, and emit a greenish fluid from the mouth ; they also emit so powerful an odour of the leaves as to scent the room they may have been placed in for observation. When full grown (see Fig. I., which shows the grubs at work on the leaves) they are about $2\frac{1}{2}$ inches in length, of a uniform velvety black, with numerous short stiff white hairs, and with six large reddish feet, apparently being destitute of the fleshy pro-legs so common in the larvæ of *Tenthridinidæ*. When feeding they keep the abdominal portion of their bodies in motion, rapping their extremities against the leaves. They bury themselves under the ground, forming brownish cocoons (see Fig. II., which are reduced in size) of a very strong texture, and from which the perfect insect emerges. When newly out of the cocoons the fly is very soft and

delicate in texture, but soon hardens by exposure to the light and air, and in a very few hours takes wing, and flies off to its natural food plants. In Victoria I have seen them only on gum trees, but in New South Wales they are said to feed also on the bottle brush (*Callistemon*). The perfect insect (see Figs. III. and IV.) has a dark metallic bluish body, with yellowish-orange scutellum, which is raised, and which imparts a somewhat singular appearance to the insect. The veins of the wings are very prominent, the antennæ being short and somewhat club shaped. On Fig. V. is shown the saw-like process (enlarged) of the female, and with this she makes the incision in which to deposit her eggs. There are a number of species of this genus in Australia, so that we have given the above brief description, although for all practical purposes the plate will be sufficient.

In Victoria we have but one insect belonging to this family which attack fruit trees, this being the well-known "Pear-slug" (*Selandria cerasi*), this, however, being an introduction from Europe.

In America and elsewhere saw flies are responsible for most of the damage done to fruits of many kinds, and although the large species under notice has so far kept away from the introduced fruit trees it is a sworn enemy of the forester, as when once a sapling is defoliated and otherwise injured by this pest, it seldom if ever makes a timber tree.

Prevention and Remedies.

In small plantations the foliage may be made obnoxious to the insect by spraying with kerosene, but on large timber areas this process would doubtless be both tedious and costly, and, as these grubs are large and easily seen, hand-picking would, next to poisoning their food, be the easiest and best way of dealing with them. One thing is certain, if eucalypts are to be grown here on a commercial basis, that pests of all kinds must be watched and kept out of the plantation if at all possible.

In India, where, however, labour is of little value, great attention is paid to these important matters, and special publications are constantly being circulated amongst the people engaged in the Forest Department, which is a large and highly remunerative one.

Our Figs. VI. and VII. show the larvæ and cocoon of some Dipterous or two-winged fly which has been found in the cocoons of some specimens from Oakleigh, near Melbourne. I am not aware of any other insect attacking the saw fly in any of its stages.

PLATE LIII.

THE "BANKSIA MOTH" (*DANIMA BANKSIÆ*, LEW.)

Fig.

1. Branch of banksia, showing larva at work. Natural size. From nature.
2. Pupa of same. Natural size. From nature.
3. Perfect insect (female). Natural size. From nature.
4. Perfect insect (male). Natural size. From nature.
- 5 & 6. Head and part of body of insects. Natural size. From nature.



CHAPTER LIX.

THE BANKSIA MOTH.

(*Danima banksiæ*, Lew.).

Order : *Lepidoptera*. Family : *Notodontide*.

This moth, the larva of which is most destructive, especially to the young banksias (native honeysuckle), is found plentifully in the Oakleigh, Brighton, and other districts situated within a few miles of Melbourne. The full-grown larvæ (see Fig. 1), which are here represented as feeding upon the leaves, are of a brown colour, with singular markings of black and white which are somewhat porcelain-like in appearance, are of the same size as those on our figure, and, when touched, have a peculiar habit of jerking their heads back towards the body (see Fig. V.) The eggs are deposited on the leaves, often upon the thin twigs of the food plant, and upon hatching out the tiny grubs commence feeding upon the leaves ; they rapidly increase in size, and are destroyers of certain trees, especially when the latter are growing near the coast, their favorite food being the leaves of the common banksia, *B. australis*, but they will, no doubt, tackle other trees as well. The mouth of the perfect insect has a strong pair of almost hidden mandibles, with which the foliage of the trees are often entirely stripped.

The pupa (see Fig. II.) is chestnut brown in colour, and is the size of our figure. When the larvæ are full fed they descend to the ground, burying themselves in the earth, usually sandy soil, and then change to the imago or perfect insect. The moth (see Figs. III. and IV.) are very handsome, being of a soft-grey colour, with black and white markings, the former colour being somewhat

more indistinct than the black, the lower wings are of a brownish grey, the body being orange black at the tail end with two prominent white blotches on the sides of the thorax and near to the head, the male being smaller than the female.

I am not sure as to when the eggs are laid, but the young larvæ may be found feeding about September, and the fully-grown ones in November, that is, in the districts previously mentioned. An allied genus, *Hyleora*, of which there are three species found in Victoria, if common, would make great havoc amongst our eucalypts. There is but the one species of *Danima* described, it having been taken very close to the city, also at Gisborne, Healesville, &c. It is a singular fact that the grub is seldom, if ever, to be found on trees fully grown, but mostly on very young, and often dwarf, saplings, which it rapidly destroys.

Fortunately it has not yet been found attacking fruit trees, but as this may any day occur it is well for growers to be able to recognise the culprit, so that prompt steps may be taken for its destruction.

• *Prevention and Remedies.*

Should this pest unfortunately make its appearance in orchards, the plants, both those attacked as well as those untouched, should be thoroughly sprayed with Paris Green, in the proportions previously recommended. Hand-picking and shaking the trees when not in fruit would also be useful, as the caterpillars are not difficult of dislodgment from the tree. It may be thought by some that this moth, although fairly common, will not be likely to become a serious pest, but judging from past experience, and a long one also, such deductions are not for a moment to be relied upon, as a change of conditions or food of an insect often causes a large increase in numbers. I recollect that many years ago a collector might have travelled for days, and although he knew where to look for them, would not be likely to find more

than a half-dozen specimens of the apple-root borer (*Leptops Hopei*), but since it has taken to our introduced fruit trees they have increased at an alarming rate, as in one orchard near Castlemaine no fewer than 1,600 full-grown beetles were taken in the one season, and many similar experiences could, if necessary, be cited.

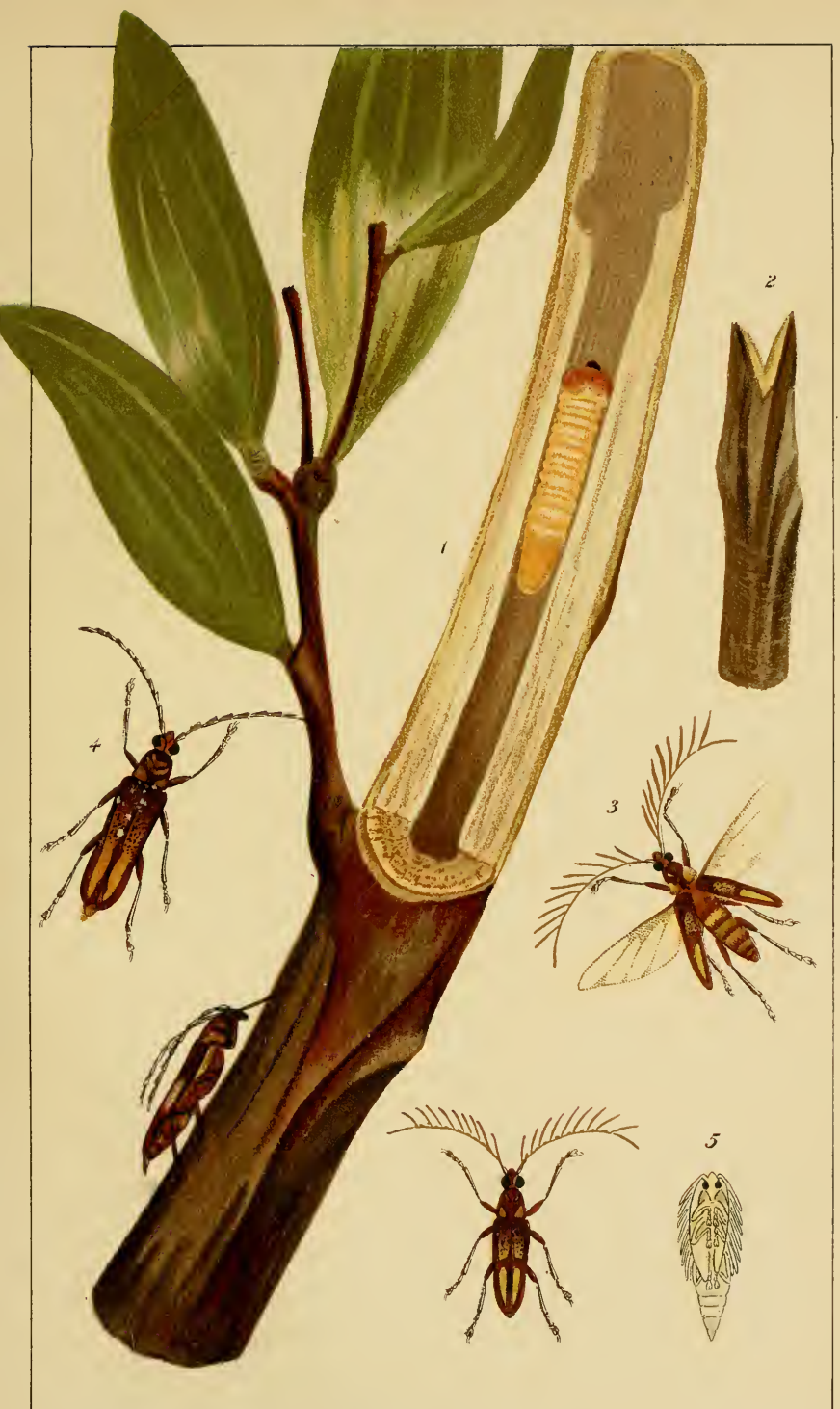
This caterpillar is occasionally attacked by the larva of a Dipterous fly, which fly is closely allied to the Muscidæ, to which group the common house fly belongs. The larvæ has also been found to have been "stung" by some Ichneumon fly, but this is of a comparatively rare occurrence. It is a singular fact that ants seldom, if ever, attack caterpillars whilst the latter are feeding on the plants, but only let them fall to the ground, then the ants, seeming at once to recognise the comparative helplessness of certain caterpillars, attack them in force, and if in sufficient numbers the caterpillar is soon torn to pieces and eaten. Should it happen, however, that the skin of the grub is tough or hard, the contents of the body are scooped out leaving the shell or covering remaining, this being a common occurrence when large Coleoptera or beetles are attacked by ants.

PLATE LIV.

THE "ACACIA BORER" (*PIESARTHRIUS MARGINELLUS*, HOPE).

Fig.

1. Branch of Acacia, showing larva and damage caused by same.
Natural size. From nature.
2. "Cut-branch," made by beetles. Natural size. From nature.
3. Perfect beetles (males). Natural size. From nature.
4. Perfect beetles (female). Natural size. From nature.
5. Pupa (male). Natural size. From nature.



CHAPTER LX.

THE ACACIA BORER.

(*Piesarthrius marginellus*, Hope.)

Order : *Coleoptera*. Family : *Cerambycidae*.

This handsome though very destructive longicorn is to be found feeding in the wood of the "Coast Acacia" (*Acacia longifolia*), a plant which assists in preventing the washing away of the cliffs, which in many places line the shores of Port Phillip, but more commonly in the wattles. Mr. Best, in his interesting series of papers on the *Longicorn Beetles of Victoria*, gives a lengthy and most interesting account of this and other kinds—these having been made by personal observations in the field. The larvæ, which bore and tunnel into the trees, are shown on Fig. I. of our plate, as also a portion of the plant in which the grubs are feeding, and a female insect crawling up the limb of the tree. The larva, which is of a yellowish-white colour, is footless, and can move fairly quickly when touched. The usual plan adopted by collectors being to first ascertain in which part of the branch the grub is and then to cut off the section, and with a piece of stick plug up the holes at each end, and in this way the beetles are easily reared for the cabinet. The eggs are deposited by the female beetle in the crevices of the bark or in the wood, and when hatched the young larvæ commence to bore into the tree, frequently killing it outright. The pupa (see Fig. V.) has nearly the form of the imago, only that it is soft in all its parts, with the legs and antennæ tucked closely into the sides of the abdomen. The males (see Fig. III.), which are smaller than the females, have the antennæ beautifully pectinated,

as shown in the plate, the female having the antennæ comparatively plain, as shown on Fig. IV., both sexes being able to fly with ease. On Fig. II. is shown the singular "cut-branch," which has been before alluded to, and the presence of which assists the collector in forming an opinion as to what portion of the tree to look for the larvæ—the detection by means of the tiny hole by which the young larvæ had entered the tree being most difficult for any one but a collector. In splitting open the wood it often happens that the insect has emerged from the pupa state, and, if sufficiently developed, a very short exposure to the air and light will enable the perfect insects to take wing, the same squeaking sound being common to this species as well as to most others of the same family. It is a most remarkable fact that the perfect insect is rarely seen unless artificially reared, and it is supposed that upon emerging from the wood the insect, when sufficiently hardened and strong, crawls up to the topmost branches of the tree, and when darkness sets in, takes flight, a peculiarity which is common to most longicorn beetles. In North Queensland the gigantic *Batocera*, longicornus the larvæ of which feed in the wood of many of the native figs (*Ficus*), are known to ascend to the tops of the branches, they having been watched after emerging from the wood. This, it is supposed, will account for the apparent scarcity of some species which are, however, fairly common.

Prevention and Remedies.

As the grubs of this beetle feed so voraciously as to destroy the tree, the branches of which, being the most frequently attacked, are the first to succumb, indications of their presence being with difficulty ascertained, in which case the affected branches should be at once sawn off and burned on the spot. In performing this operation, however, care must be taken to examine the affected branches carefully, as it often happens that the larvæ after having destroyed the branches descend into the

stem, and as the grubs remain for a long while—probably a couple of years—in the wood it will readily be seen how great is the damage that may be done during this time.

To those of us who are interested in the preservation of our costal timber belts as we have before stated, and without which vegetation serious inroads of the sea must and is being made, and great is the damage which has been done to the native trees to these and insects of a kindred nature, where the work of destruction appears to be going on uninterruptedly. As a rule, and fortunately for us, the “Coast Tea tree” (*Leptospermum lævigatum*) is affected by very few serious diseases, the principal being caused by the work of one of the *Cecidomyia*, of which group the celebrated “Hessian Fly” is a member, and which forms a kind of “gall” on the branches; also from some of the *Psychidæ*, the case-enclosed larvæ of which feed upon the leaves but do but comparatively little harm.

The beautiful she-oaks (*Casuarina*), which, in full vigour, once lined the sea coasts in the localities mentioned, are rapidly dying out, a large and singular scale insect (*Frenchia Casuarinæ*), which the late Mr. Maskell has so ably described, having destroyed a large number of these valuable trees.

This is a matter which the Forest Branch might well take up, and the co-operation of this branch of the Agricultural Department would be readily forthcoming.

PLATE LV.

THE "WHEAT MOTH" (*TINEA GRANELLA*). LINN.

- Fig.
1. Perfect insect. Magnified. From nature.
 2. Perfect insect Natural size. From nature.
 - 2A. Perfect insect. Natural size. From nature.
 3. Growing wheat and grains injured by larvæ. Natural size. From nature.
 4. Pupa. Natural size. From nature.
 5. Ovipositor of female. Magnified. From nature.
 6. Larva. Natural size. From nature.



C.C. Endicott Del

C. French, Engraver

Printed & Published by J. H. Smith

Plate LV.

CHAPTER LXI.

THE WHEAT MOTH.

(*Tinea granella*, Linn.)Order : *Lepidoptera*. Family : *Tineidæ*.

This moth, when in the larval state, is very destructive to wheat and barley crops, as it attacks the grain just when the latter is commencing to swell. The colour of the moth (see Fig. I., which is magnified) is of a rich brownish yellow, with larger greenish yellow under wings, and is the size of those shown (see Figs. II. and IIA.) The larvæ, which are small and active, are of the size of those figured (see Fig. VI.), the pupa being brown as shown (see Fig. IV.) When the ears are attacked the caterpillars bore into the grain (see group), and eating out the contents, leaving nothing but the husks remaining. Barley and wheat are attacked in exactly the same manner, and when the grubs are at work the plants on which they appear turn a sickly yellow colour, differing somewhat in appearance to those which are ripe. This moth belongs to a family of which there are a large number of genera and species, and by reason of their small size are known to collectors as *Micro-lepidoptera*. In most countries, excepting, of course, those situated in the extreme northern and southern latitudes, these small moths are very numerous, numbering at a low estimate many thousands of species, many of these, as the codlin moth, potato moth, cabbage and clothes moths, being amongst the most troublesome of known insects. In Victoria we have a large number of the *Micro-lepidoptera* new genera and species constantly turning up. Many of these insects

are almost microscopic in size, and are not infrequently mounted on glass slides for microscopic observations. As a rule the larvæ of nearly all the Tineid moths, also their close allies, feed upon or within the leaves of plants, but many, as we all know, live within nuts and fruits, dried as well as fresh. A few feed upon dead animal matter, as woollens, furs, feathers, and some, as Professor Comstock remarks, are predaceous, destroying the so-called scale bugs; and again referring to the probable number of species of this group, Professor Comstock, in his noble work, *Manual for the Study of Insects*, says there are over one thousand described species in America alone. In America they have a very serious pest, "The Apple Bacculatrix" (*Bacculatrix poniofotella*), which as this pest may some day be introduced here by means of the American apple cases or in packing I have thought it better to give some account of as described by Professor Comstock in the work above alluded to. "This insect differs in habits in several respects from any of the Tineids described here. The larva infests the leaves of the apple, and when full grown it makes a small white cocoon, which is attached to the lower surface of a twig. The cocoons sometimes occur in great numbers, side by side, on the twigs of an infested tree. They are easily recognised by their shape, being slender and ribbed lengthwise. It is these cocoons that usually first reveal the presence of this pest in an orchard. They are very conspicuous during the winter, when the leaves are off the trees. At this time each cocoon contains a pupa. The adult moth emerges in early spring (about September and October in the north-east and north-west part of Victoria). The eggs are laid on the lower surface of the leaves. Each larva, when it hatches, bores directly from the edge to the upper surface of the leaf, where it makes a brown serpentine mine. When these mines are abundant in a leaf it turns yellow and dies. When the larva has made a mine from one-half to three-fourths of an inch long, which it does in from four to five days, it eats its way out

through the upper surface. Then somewhere on the upper surface of the leaf it weaves a circular silken covering about one-twelfth inch in diameter. Stretched out on this network the larva, which is now about one-tenth inch long, makes a small hole in it near its edge, then, as one would turn a somersault, it puts its head into this hole and disappears beneath the silken covering, where it undergoes a change of skin. It remains in the moulting cocoon usually less than twenty-four hours. After leaving this cocoon it feeds upon the leaves without making a mine; and in a few days makes a second moulting cocoon, which differs from the first only in being about one-eighth inch in diameter. After leaving this it again feeds for a few days, and then migrates to a twig, where it makes the long-ribbed cocoon within which the pupa state is passed. This very interesting life-history was first worked out by Mr. A. E. Brunn, while a student in the writer's laboratory at Cornell University. When it is necessary to combat this pest the smaller twigs bearing cocoons should be pruned as far as practicable during the winter and burned, and those cocoons that remain on the large branches should be washed with kerosene or kerosene emulsion."

Prevention and Remedies.

We have previously mentioned that nearly the whole of these insects when in the larval stage are vegetable feeders, so as to prevent the egg-laying, all the grass and other herbage growing on headlands, or in the vicinity of the cultivated paddocks, should be kept down by either ploughing, burning, or by other means. It is a good plan to sow strips, or belts, of any succulent plants which would not be likely to become noxious weeds, such as castor oil, larkspur, &c., both of which are hardy and of rapid growth, and have the merit also of being deadly to caterpillars eating the leaves. If possible, these strips should be confined by fencing, so that cattle, horses, and

sheep could not get at the plants. When pests of this kind get into a crop it becomes a matter of great difficulty, also of expense, to deal with them successfully; still the crop, if it is to be saved, something must be attempted, or straw instead of grain will be forthcoming. I have already alluded to the Strawsonizer and larger spraying machines, the former being largely used in England for crops on areas of considerable size.

PLATE LVI.

THE "TRIANGULAR-MARKED BANKSIA BEETLE" (*URACANTHUS TRIANGULARIS*, HOPE.)

Fig.

1. Banksia branch, showing larva, pupa, and perfect insects, and damage done to tree. Natural size. From nature.
2. Cut-branch made by insects. Natural size. From nature.
3. Perfect beetle (female). Natural size. From nature.
4. Perfect beetle (male). Natural size. From nature.



G. Brittlebank Del.

G. French Direxit

Troedel & Co Lith

Plate LVI.

CHAPTER LXII.

THE TRIANGULAR-MARKED BANKSIA BEETLE.

(*Uracanthus triangularis*, Hope.)

Order : *Coleoptera*. Family : *Cerambycidae*.

This very handsome longicorn beetle is one of twelve other species which has been described as being indigenous to Australia, it having been found in New South Wales, Queensland, Tasmania, and in Victoria, and probably occurs also in South and in West Australia. The eggs of this insect are deposited by the female in the smaller branches of the trees on which the larvæ feed, our present figure being drawn from a portion of *Banksia* branch found at Cheltenham, on the shores of Port Phillip Bay. When the young grubs emerge from the eggs they are of course very small, but very soon commence to eat into the wood of the tree, which they bore and tunnel in a most surprising manner. When full grown they are the size of that shown on Fig. I. of our plate, the tree being the so-called "Coast Honeysuckle" (*Banksia integrifolia*) which line the coast in many parts of Victoria. As the larva increases in size, the more rapidly it works, and when full fed assumes the pupa stage which, as shown in our figure, is a singular mummy-like form, and which in course of time develops into the perfect insect. One singular habit which many beetles of this family possess is that of cutting to the shape of a stock about to receive a scion (see Fig. II.) off the top of the small branches, and as there is usually a small portion of sawdust-like matter slightly protruding from the upper portion of the V-shaped cut this renders the

“cut-branches,” as Entomologists term them, much easier of detection, and even with this advantage it takes a fairly well-trained eye to find them.

In this family of the *Coleoptera*, or beetles, the males are usually much smaller than the females (see Figs. III. and IV.), the whole group, with but comparatively few exceptions, being very destructive to timber even of the hardest kinds, the larvæ being furnished with very powerful jaws with which they gnaw the wood of the trees attacked. When the perfect insect emerges from the wood, which it does by eating its way out, the wing-cases and other parts soon harden by exposure to the air which enables the beetles to take wing, being mostly nocturnal in their flight, in a comparatively short time after seeing the light. As to how long these grubs, which by the way are legless, remain in the wood, I cannot say, but have kept them for over twelve months before the perfect insect has emerged, so that it will be seen that when working all this time in a tree great damage must ensue. When handled the beetles, which are the colour of those here figured, make a peculiar squeaking noise and will make an attempt to bore into the closed hand which is holding them. This species is by no means confined to *Banksia* trees, as its larvæ are very destructive also to wattles, boring and tunnelling in all directions. As a rule the grubs of this beetle feed, as I have before stated, in the smaller branches of the tree, but in another species (*Uracanthus simulans*) they bore right down the stem into the main tap root underground, a particular kind of native tree aster being their favorite food. A third species (*U. bivitta*) feeds in several woods including that of the common European Furze (*Ulex*) which it rapidly destroys. A fourth, a large and fine species, has, during the last few years been found destroying orange trees on the Richmond river in New South Wales, and has been described by the late Mr. S. Olliff as *U. cryptophagus*.

When trees of any kind are attacked by longicorn larvæ, it is astonishing in what a comparatively short

time they turn sickly and die off, and all along the coast instances are but too frequent of the damage done by these insects. It has often been a marvel to others as well as to myself how it is that, although we find orchards planted right in the depths of our most dense forests, the fruit trees contained therein are so rarely attacked by beetles of this large and important family, of which family in Australia alone there cannot be less than 1,200 distinct species, in sizes varying from the tiny Victorian species (*Allomicrus exiguus*) which has recently been described by Mr. Gahan as a new insect, to the gigantic *Batocera Wallacei*, which has been recorded by myself as having been found in Australia, New Guinea being formerly its only known habitat, the latter beautiful species often attaining with antennæ and legs stretched out straight out from the body a length of 10 inches, and we can easily imagine the vast amount of damage the grubs of these large beetles are capable of doing.

Prevention and Remedies.

To treat trees for borers of this type the steam sprayer, by which sulphur or other material, as carbolic acid, could be forced into the holes in vaporized form and as hot as possible, appears to be the best yet attempted, but even this could not, without great trouble and expense, be carried out in the case of large forest trees, but in fruit trees or even on avenue trees it can be done when it resolves itself simply into the question of cost.

In America one of this family of beetles (*Saperda candida*) better known to orchardists as the "Round-headed Apple Tree Borer" does an immense amount of damage to apple trees, and with the exception of the codlin moth is there considered to be the worst enemy of the apple with which they have to deal.

In searching the timber for specimens of this beetle it is no uncommon occurrence to come across larvæ and pupæ of a wasp-like insect (*Odynerus*) in which have

been found no less than ten pupæ in the one small twig, and thus it happens that this borer beetle is kept within reasonable bounds. There are several others but smaller *Hymenoptera* which attack this beetle when in the larvæ and pupæ state, many of the latter having been reared from the branches collected.

There is a danger, as we in this colony have previously experienced, of this class of beetle being introduced here in the larval form by means of timber, as most longicorns, unlike many of the moths, appear to be perfectly at home in logs, no matter how dry the wood may be, and it is by these agencies that the little longicorn beetles which some time since destroyed the wooden hoops on the kegs of powder in our powder magazine have been introduced from the continent of Europe. Let us hope that our fruit trees will escape attack from this class of insect, but in any case, to quote an old proverb, to be forewarned is to be forearmed. In the best-regulated American institutions figures of at least all the worst of the insects known to be destructive to vegetation are in the splendid publications which are from time to time issued by the Americans fully dealt with, these publications being in great demand everywhere.



W. T. A. Brittlebank, Del.

C. French, Direct

Plate LVII. " White-eyebrowed Wood-Swallow."
Artamus superciliosus (Gould)

Treadel & Co Lith.

CHAPTER LXIII.

THE WHITE EYEBROWED WOOD SWALLOW.

(*Artamus superciliosus*, Gould.)

This valuable insect-destroying bird, which in the summer time is to be seen in large numbers in the country districts of Victoria, in the early days of the colony was known to all country people as the "summer bird," a name which, considering it appeared only in the summer, was not by any means an inappropriate one.

The following is a description of the bird, its nest, and eggs, by Mr. A. J. North, Ornithologist, of the Australian Museum, Sydney :—"This bird is strictly migratory, arriving in Victoria to breed about the end of November, and departing again at the commencement of March. Sometimes, however, three, four, and even five years elapse without seeing a single specimen, and it is remarkable when they visit us in great numbers, as far south as Melbourne, that it is during a period of drought in the interior. It builds a round and almost flat scanty nest of roots and grasses, through which the eggs in some situations can be seen from below in every possible position, both in the indigenous and acclimatised trees of our public parks and gardens. In Albert Park I have found no less than ten nests, each containing eggs, in a single row of Pines (*Pinus insignis*) of about 50 yards in length; the trees at that time being of a uniform height of 5 feet. At other times the nest is placed in the horizontal fork of the Eucalypti or Acacia, in the broad flat leaves of the Norfolk Island Pine (*Araucaria excelsa*), and on two occasions I have found it in the leafy top of a rose bush. The eggs are three in number, usually of a

buff-white ground colour, blotched and freckled all over with light-brown and umber-brown markings, particularly towards the larger end. Occasionally one egg in a set is found of a dull-white ground colour, with a well-defined zone of dark umber round the larger end."

This Wood Swallow is well known to colonists as one of their best bird friends, and, being in such large numbers, they destroy an enormous number of insects of all kinds. Unfortunately, however, the nests being so exposed rendered these an easy prey to the itinerant sportsman, also to the egg hunter, the former nuisance being largest responsible for the wholesale destruction of the bird life of the colony. When closing this chapter a report has been received from the Inspector who was sent up to the north-west part of the colony to study the locust pest, and to conduct experiments with the locust fungus, to the effect that of all the birds which had been attacking the locusts the Wood Swallow had done the best work, the birds being in large flocks, and devoted themselves entirely to locust destruction.

If ever there was a bird which deserves the protection of every man, woman, and child in Victoria it is the Wood Swallow, this useful and pretty harbinger of summer.



J. G. Littlebank, Del.

Plate LVIII.

C. French, Direct.
" White-rumped Wood-Swallow "
Artamus leucogaster (Valenc.)

Troedel & Co. Lith.

CHAPTER LXIV.

THE WHITE-RUMPED WOOD SWALLOW.

(Artamus leucogaster, Val.)

This bird, although one of the best as a destroyer of insects, is unfortunately somewhat rare in most places of Victoria, but in some of the Murray districts it is fairly common. The late Mr. Gould, in his magnificent work on the birds of Australia, says of this species—"That on the Rivers Mokai and Namoi, situated to the northward of Liverpool Plains, New South Wales, he found it breeding among the large-flooded gum trees bordering the rivers, and remarks that the breeding season in the localities commences in September and continues until January, during which period at least two broods are reared. In the Christmas week of 1839, at which times I was on the plains of the interior, in the direction of Namoi, the young progeny of the second brood were perched in pairs or threes together on a dead twig near their nest. They were constantly visited and fed by the adults, who were hawking about for insects in great numbers, some performing their evolutions above the tops and among the branches of the trees, while others were sweeping over the open plain with great rapidity of flight, making in their progress through the air the most rapid and abrupt turns; at one moment rising to a considerable altitude and the next descending to within a few feet of the ground, as the insects of which they were in pursuit arrested their attention. In the branches, the flight of this bird is more soaring and of a much shorter duration, particularly when hawking in the open glades, which frequently teem with insect life. When flying

near the ground the white mark on the rump shows very conspicuously, and strikingly reminds one of the House Martin of our own country."

Two nests, taken by Gilbert on a small island in Coral Bay, near the entrance of the harbor at Port Essington, were completely formed of dry wiry grass and the fine plants growing on the beach, they were placed in the fork of a slender Mangrove tree, within 15 feet of the water, in which they were growing; but like several other Australian birds, this species often avails itself of the deserted nests of other birds instead of building one of its own. Most of those I found breeding on the Mokai had possessed themselves of the forsaken nest of the Grallira, which they had rendered warm and of the proper size by slightly lining it with grasses, fibrous roots, and the narrow leaves of the eucalypti.

The colour of this bird, as shown on our plate, is of a leaden black with bluish bill, and belly white, and in common with our other bird plates is shown in its natural size. There are two other beautiful and useful species, viz., *A. sordidus* and *A. personatus*, which we hope to figure in Part IV. of the book.



C.C. & T.A. Brittonbank. Del.

C. French. Dressed.

Sands & McDougall. Tint. & Inkh.

"NARROW-BILLED BRONZE CUCKOO."
Lanquarocorys basalis, (Horsfield.)

CHAPTER LXV.

THE NARROW-BILLED BRONZE CUCKOO.

(*Lamprococcyx basalis*, Horsfield.)

This very pretty species is one of the most useful birds of the group to which it belongs. The Bronze Cuckoo is to be found in many parts of the colony, and is not uncommon a few miles out of Melbourne.

This bird subsists almost entirely upon insects, which it destroys and eats with avidity. Grubs of all kinds would appear to be the favorite food of this bird, and hardly any of the ordinary-sized larvæ are exempt from its attack, the caterpillars of the vine being specially selected by this bird for destruction, so that immense numbers of the grubs are killed.

It is somewhat singular that so very few birds will tackle the grub of the Vine Moth, so that the Cuckoo requires our special protection.

Like all Cuckoos, this bird is strictly parasitic, and deposits its eggs in the nests of most of our small insectivorous birds.

Mr. North says—"The egg of this species is pinky white, minutely freckled all over the surface with light brownish-red or pinkish-red dots and spots; in some instances these markings are confluent, forming coalesced patches on the egg, but on no particular portion of it, sometimes being on one side only, at other times on the end." The coloring matter of this and the preceding species is easily rubbed off when moisture is applied to them.

The colour of the bird, as described by Gould, is—
“Crown of the head and nape bronzy brown; over the eye a stripe of dull white; feathers of the back, wing coverts, upper tail coverts, and two centre tail feathers dark shining green, edged with grey; wings brown, glossed with green and margined with grey; outer tail feathers on each side alternately and broadly barred with blackish brown and white; the three rest on each side rufous chestnut at the base, passing into green towards the extremity, and ending in blackish brown, specked with white; ear coverts and sides of the neck brown; under surface buffy white, mottled bars of pale brown on the throat, and strongly barred on the flanks with bronzy brown; under surface of the shoulder similarly but not so strongly barred.”



CC. & T. A. Brittlebank, Del.

C. French, Direct.

Sands & McDougall Lith.^d Lith.

"PALLID CUCKOO."

Cacomantis pallidus, (Latham.)

Plate LX.

CHAPTER LXVI.

THE PALLID CUCKOO.

(*Cacomantis pallidus*, Lath.)

We now come to two birds, which, for their size, are probably the best insect-destroying birds in Victoria. The Pallid Cuckoo also the Narrow-billed Bronze Cuckoo are the only two birds which, in my experience, will eat the common Vine Caterpillar (*Agarista glycine*) and larva of the Cut Worm (*Agrotis*). In many parts of the colony this bird is still fairly common, but anywhere near to Melbourne it has been shot or otherwise destroyed, so that it is much rarer than it was in the early days when there were no railways to convey shooting parties on their mission of destruction to bird life, all and sundry. The cuckoos are most singular in their economy, and Messrs. North, A. J. Campbell, and Kearnland, and others of our Victorian ornithologists could doubtless relate some curious experiences with these birds, some of the habits of which are most interesting. These birds are migrants in Victoria, usually arriving in the early spring, and taking their departure in the autumn, passing the winter in tropical Australia. They are early risers and their oft-repeated notes may be heard long before daylight, and frequently as late as nine p.m. They are generally seen singly or in pairs, but never in flocks. Although they frequently deposit their eggs in the nests of the smaller Honeyeaters, the Wattlebird, Mud Lark, Oriole, and English Linnet also act as foster-parents to this Cuckoo. The egg of the Pallid Cuckoo (*C. pallidus*) closely resembles those of the Yellow-tufted Honey-eater (*Ptilotis auricomis*), they are, however, somewhat larger, and of

a much lighter tint, being of a pale-flesh colour, sprinkled with a few dots of deeper hue, but often without any markings at all. This species appears to have a wide distribution as it has been found, according to Dr. Ramsay, in all the colonies as far north as Derby, in North-west Australia, the Gulf of Carpentaria, and down to New South Wales, South Australia, Tasmania, West and South-west Australia.

Gould, in writing of this bird, says—"The southern part of Australia generally and the Island of Tasmania are inhabited by this species of Cuckoo; to the latter country, however, it is only a summer visitant, and a partial migration also takes place in the adjacent portion of the continent, as is shown by its numbers being much fewer during winter. It arrives in Tasmania in the month of September and departs northward in February. During the vernal season it is an animated and querulous bird, and may then be seen singly or two or more males engaged chasing each other from tree to tree. Its singing-whistling call, which consists of a succession of running notes, the last and highest of which are several times rapidly repeated, is often uttered while the bird is at rest among the branches, and also occasionally while on the wing. Its food consists of Caterpillars, Phasmidæ, Mantidæ, and Coleopterous insects, which are generally procured among the leafy branches of the trees, and in searching for which it displays considerable activity and great power of traversing the smaller limbs. When desirous of repose after feeding it perches on the topmost dead branches of the trees, on the posts and rails of the fences, or any other prominent site whence it can survey all round. Its flight is straight and rapid, and not unlike that of *Cuculus canerus*. In respect to its reproduction it is strictly parasitic, devolving the task of incubation on the smaller birds, many species of which are known to be its foster-parents."

The adult male has the head, neck, and all the under surface brownish grey, with a streak of dark brown down

the sides of the neck ; all the upper surface olive brown, becoming much darker on the wings and tail ; basal portion of the inner webs of the primaries broadly barred with white, slightly on the outer and deeply on the inner ; all feathers tipped with white, and with a mark of white on the stems near the tip, this mark being very small on the central tail feather and gradually increasing in the lateral feathers until on the outer it forms a band, under irides very dark brown, eyelash yellow, gape and inside of the mouth rich deep orange, feet olive.

The female differs in having the upper surface mottled with buff and rufous, in having a triangular spot of reddish buff at the extremity of each of the wing coverts, and the markings of the tail buff instead of white ; all whitish markings may in very old birds give place to a style of coloring similar to the male.

As there are several Cuckoos, it has been thought better to give the description in full, so that no mistake can occur in identification, the plates having been prepared by the Messrs. T. and C. C. Brittlebank.



CHAPTER LXVII.

THE RESTLESS FLYCATCHER.

(Seisura inquieta, Latham.)

This valuable insect-destroying bird is fairly common in many parts of Victoria, and the figure on plate will enable any one to recognise it at a glance. In describing the nest and eggs of this bird, Mr. North says—"The nest of this Flycatcher, like those of most of the family, is round and cup shaped, $2\frac{1}{2}$ to 3 inches across by $1\frac{1}{4}$ deep, and placed upon a horizontal bough over a fork, or by the side of an upright twig; it is chiefly composed of bark and grass neatly interwoven; the lining is of grass, hair, or roots, and the edges often ornamented with lichen fastened on by cobweb. It is usually placed at a considerable distance from the ground, and often near the end of a dead bough. The eggs are two or three in number, from 9 to $10\frac{1}{2}$ lines in length by $7\frac{1}{2}$ in breadth, rather rounded in form, having the ground colour of a dull white stained with spots and blotches of dull chestnut brown and greyish lilac, the latter appearing as if beneath the surface. In most of the specimens the spots form only a distinct zone near the larger end, but in some are sprinkled over the whole surface. The birds are for the most part found breeding in October, November, and December, but sometimes earlier or later. They have two broods in the year."

According to Gould—"This species ranges over the whole of the southern portion of the Australian continent (Mr. North records it as far north as Rockingham Bay, Northern Queensland), and appears to be as numerous in many parts of Western Australia as it is in New South Wales, where it may be said to be universally distributed, for I observed it in every part I visited, both among the brushes as well as in the more open parts of

the country, in all of which it is apparently a stationary species. It is a bird possessing many peculiar and very singular habits. It not only captures its prey after the usual manner of the other Flycatchers, but it frequently sallies forth into the open glades of the forest and the cleared lands, and procures it by posing itself in the air with a remarkably quick motion of the wings, precisely after the manner of the English Kestrel (*Tinnunculus alaudarius*), every now and then making perpendicular descents to the ground to capture any insect that may attract its notice. It is while performing these singular movements that it produces the remarkable sound which has procured for it from the colonists of New South Wales the appellation of the "Grinder." The singular habits of this species appear to have attracted the notice of all who have paid any attention to the natural history of New South Wales. Mr. Caley observes—"It is very curious in its actions. In alighting on the stump of a tree it makes several semicircular motions, spreading out its tail at the time, and making a loud noise somewhat like that caused by a razor grinder at work. I have seen it frequently alight on the ridge of my house and perform the same evolutions." To this I may add the following account of the actions and manners of this species as observed by Gilbert in Western Australia:—"This bird is found in pairs in every variety of situation. Its general note is a loud harsh cry, several times repeated; it also utters a loud clear whistle; but its most singular note is that from which it has obtained its colonial name, and which is only emitted while the bird is in a hovering position at a few feet from the ground. This noise so exactly resembles a grinder at work that a person unaware of its being produced by a bird might easily be misled."

It may here be mentioned that mounted specimens of the birds shown in our plates, together with the nests and eggs of same, may be seen in the Museum of Economic Entomology and Ornithology which is attached to the office of the Government Entomologist.



C.C. & T.A. Britton & Co. Del.

Plate LXII.

C. French. Drest.

"WHITE SHAFTED FANTAIL."

Rhinidroma albisquamis (Gould.)

Sanders & McJannet. Engr. & Lith.

CHAPTER LXVIII.

THE WHITE-SHAFTED FANTAIL.

(Rhipidura albiscapa, Gould.)

A well-known favorite, commonly to be seen almost anywhere in the country around Melbourne. It is easily known by its quick movements and its habit of spreading out its tail whilst hopping about the twigs in search of insects, although, as a rule, most of the insects taken by it are captured whilst on the wing. Of this bird Mr. North says—"This lively and interesting little bird is plentifully distributed throughout Queensland, New South Wales, Victoria, and South Australia, and although it has nothing to recommend it in the sombre tints of its plumage the remarkable shape of its nest attaches to it an interest that renders it one of the most conspicuous of the smaller birds of the Australian bush."

A nest of this species now before me is funnel shaped, or like a wine-glass with the base broken off. It is composed of strips of very fine bark closely interwoven and securely held together on the outside with spider's web, which is neatly wound round the exterior portion of the nest proper, the thin branch on which it is placed and the upper portion of the stem-like appendage which extends below the branch from the bottom of the nest. The lower portion of the stem is ragged at the end, and just sufficient web is placed around it to hold together the fine shreds of bark of which it is composed.

The interior of the nest is lined entirely with fine fibrous roots, and the rim of the nest is very thin; external diameter, $1\frac{7}{8}$ inch; depth, $1\frac{3}{4}$ inch; length of stem below the nest, 2 inches; thickness near the end, $\frac{1}{4}$ of an inch; internal diameter, $1\frac{7}{8}$ inch; depth, $1\frac{1}{8}$ inch.

The nest of this bird is placed in a variety of situations, sometimes on the thin branch of a *Melaleuca* (Tea-tree), within a few feet of the ground, but not unfrequently on one of the topmost branches of an *Acacia*, or tall gum sapling, 20 feet from the ground. Eggs, two or three in number for a sitting, of a dull and, in some instances, creamy-white ground colour, thickly spotted with brown markings, intermingled with a few obsolete spots of bluish-gray towards the larger end, where they become confluent, and form a well-defined zone. This species commences to breed in October and continues the two following months.

“In Tasmania,” Mr. Gould remarks, “I have seen the White-shafted Fantail in the depth of winter in the gullies on the sunny side of Mount Wellington; and it is my opinion that it only retires at this season to such localities as are sheltered from the bleak south-westerly winds which then so generally prevail, and where insects are still to be found. The bird is also subject to the same law on the continent of Australia; but as the temperature of that country is more equable its effects are not so decided; and, in support of this opinion, I may adduce the remark of Caley, who says—‘The species is very common about Parramatta, and I do not recollect having missed it at any period of the year. It is generally found in pairs, but I have occasionally seen as many as four or five together. It inhabits alike the topmost branches of the highest trees, those of a more moderate growth, and the shrouded and gloomy-foliaged dells in the neighbourhood of rivulets; from these retreats it darts out a short distance to capture insects, and in most instances returns again to the same branch it had left. While in the air it often assumes a number of lively and beautiful positions, at one moment mounting almost perpendicularly, constantly spreading out its tail to the full extent, and frequently tumbling completely over in the descent; at another it may be seen flitting through the branches, and seeking for insects among the flowers and leaves,

repeatedly uttering a sweet twittering song. In its disposition this little bird is one of the tamest imaginable, allowing of a near approach without evincing the slightest timidity, and will even enter the houses of persons resident in the bush in pursuit of insects. During the breeding season, however, it exhibits extreme anxiety at the sight of an intruder in the vicinity of its nest.' "



A. T. L. Frittelink Del.

J. French. Duxit

Troedel & Co. Lith.

"Brown Tree-Creeper."

Climacteris scandens, (Temminck)

Plate LXIII.

CHAPTER LXIX.

THE BROWN TREE CREEPER.

(*Climacteris scandens*, Temm.)

The Tree Creepers, both Victorian species, are among the best of our insectivorous birds, as, although small in size, they are always at the work, and may be seen creeping, or rather hopping, up the trees in search of insects, which are their sole food. Mr. North says—"This bird is to be found breeding freely throughout New South Wales, Victoria, and South Australia ; constructing a nest of grasses, fur, &c., usually in the hole of some decayed branch or spout of a Eucalyptus, and occasionally out of arm's reach. The eggs, two in number for a sitting, are of a reddish-white ground colour, closely freckled all over with rich reddish markings towards the larger end, where in some instances they form a zone. The breeding season commences in August, and lasts till the end of December. Gould, in his *Handbook to the Birds of Australia*, says—"The Brown Tree Creeper inhabits the whole of the south-eastern portion of the Australian continent from South Australia to New South Wales. It gives a decided preference to the open thinly-timbered forests of Eucalypti, the bark of which, being mostly rough and uneven, affords numerous retreats for various tribes of insects. Its food, however, is not only sought for upon the boles and branches of the trees, but is obtained by penetrating the decayed and hollow parts, and it even dives into the small hollow spouts of the branches in search of spiders, ants, and other insects. Although its form would lead to a contrary supposition, it spends much of its time on the ground, under the

canopy and near the boles of the larger trees, in a similar pursuit, and also traverses the fallen trunks with a keen and scrutinizing eye. While on the ground it has a pert lively action, passing over the surface in a succession of quick shuffling hops, carrying its head erect with the feathers puffed out, almost in the form of a crest. Among the trees it assumes all the actions of a Tree Creeper, ascending the upright boles, and traversing with the greatest facility both the upper and lower branches. It never descends with the head downwards, like the members of the genera *Sitta* and *Sitella* ; still, I have seen it descend an upright bole for a short distance by hopping or shuffling backwards, as it were, generally making a spiral course.

“It flies with a skimming motion of the wings, during which the brown marking of the primaries is very conspicuous.

“Like many other insectivorous birds in Australia it seldom, if ever, resorts to the water for the purpose of drinking. It has a sharp piercing cry, which is frequently uttered, especially if the tree upon which it is climbing be approached.

“Little difference is observable either in the colour or size of the sexes ; the female may, nevertheless, be at once distinguished from the male by the spots at the base of the throat being rufous instead of blackish brown, as in the male.”

In Australia there are three other species of these very useful little birds, but so far we have no record of their having been found in Victoria.



W. A. Brittlebank, Del.

C. French, Dixit

Troedel & Co. Lith.

"White-throated Tree-Creeper"
Climacteris leucophloea, (Latham).

Plate LXIV.

CHAPTER LXX.

THE WHITE-THROATED TREE CREEPER.

(*Climacteris leucophæa*, Tatham.)

This elegant little bird, which any day may be seen creeping, often spirally, up the trunks and branches of trees, is also a most valuable insect-eating bird, the stomach of one which I dissected being filled with beetles, grubs, and other insect débris.

Gould says of this bird—"That the range of this species is widely extended as that of the *Climacteris scandens*, being a common bird in New South Wales and the intervening country, as far as South Australia; the precise limit of its habitat northward have not been ascertained, but it does not form part of the fauna of Western Australia."

The whole structure of this species is much more slender and creeper-like than any other member of its genus, and I observed that its difference of form has a corresponding influence over its habits, for they are more strictly arboreal than those of its congeners. It also differs from *C. scandens* in the character of country and kind of trees it inhabits, being rarely seen on the large Eucalypti of the open forest lands, but resorting to trees bordering creeks, as well as those on the mountains and the brush. I have frequently seen it in the brush of Illawarra and Maitland, in which localities the *C. scandens* is seldom if ever found. While traversing the trunks of trees in search of insects, which it does with great facility, it utters a shrill piping cry; in this cry, and, indeed, in the whole of its actions, it strikingly reminded me of the Common Creeper of Europe (*Certhia familiaris*), particularly in its manner of ascending the

upright trunks of the trees, commencing at the bottom, and gradually creeping up the bole to the top, generally in a spiral direction. It is so partial to the *Casuarinæ* that I have seldom seen a group of those trees without at the same time observing the White-throated Tree Creeper, their rough bark affording numerous receptacles for various kinds of insects, which constitute its sole diet.

The White-throated Tree Creeper is very plentiful in the neighbourhood of Ringwood, Croydon, Bayswater, and other parts of Victoria, where it renders valuable service in destroying many insect pests in the orchards. I have counted as many as thirteen in one orchard searching for insects on the fruit trees and amongst the strawberry plants. They were so intent on their work as to permit me to approach close enough to see them extracting small grubs from the crevices in the bark on the fruit trees.

The breeding season is September and the three following months, during which time they usually rear two broods. The nest is built of grasses, is warmly lined with feathers, and is placed in the hollow branch or bole of a tree. The eggs are two in number, of a dull white, thinly speckled with fine spots of rich brown and a few larger blotches of the same colour.

The female is precisely the same in colour, with the exception of having a small orange-coloured spot just below the ear coverts, and by which she is at once distinguished from the male.

CHAPTER LXXI.

FUMIGATION.

(Hydrocyanic-gas Treatment.)

“Dr. Coquillet was the first to suggest and use this gas for the destruction of scale insects. His experiments, according to Professor Lodeman, began in September, 1886, in the orange grove of J. W. Wolfskill, of Los Angeles, California. Its use has been followed by such good results that all other gases have been abandoned in treating these pests.

“The gas is prepared by using—

Cyanide of Potassium, 60 per cent., 1 ounce.

Commercial Sulphuric Acid, 1 fluid ounce.

Water, 3 fluid ounces.

“Potassium cyanide of 90 per cent. has also given excellent results. The water is first placed in an open glazed vessel, and then the acid is added. When the parts to be treated are all covered the diluted acid is placed under the tent, the cyanide of potassium is dropped in, and the tent immediately closed. The gas is exceedingly poisonous, and should not be inhaled. The amount formed with the above materials is sufficient for a confined space containing 150 cubic feet. It is safer to use the gas upon dormant trees and during cool weather or at night, since trees are more easily injured during a high temperature; treated parts should remain covered about an hour, and to work the thing properly several tents should be in use at once; this to prevent loss of time on the part of those engaged in the operation of fumigation. The following table, giving height of trees and the proportions

of chemicals and water, will be found suitable for districts in the interior or beyond 10 miles in a direct line from the sea-coast:—

Height of Tree.	Diameter through Foliage.	Water Fluid.	Sulphuric Acid Fluid.	Cyanide of Potassium.
Feet.	Feet.	Ounces.	Ounces.	Ounces.
6	4	2	1	1
8	6	4	2	2
10	8	6	3	3
12	10	10	5	5
14	14	16	8	8
16	16	18	9	9
18	16	20	10	10
20	16	22	11	11
22	18	24	12	12
24	20	26	13	13
26	20	27	13½	13½
30	20	28	14	14

“One would suppose that an orange tree having a dense foliage would fill up the space within the tent, and require less gas to be effective. But the cold surface of the leaves condenses the gas, and fumigators find that a slightly heavier charge of chemicals is necessary for such a tree, and where the foliage is scant a less amount than is given in the table will answer. Some orchardists and fumigators consider that the work has not been effective unless some of the leaves or tender twigs have been injured. This is not necessary, for in our early experiments we have treated trees and killed the scale without even injuring the most tender twig or blossom. As the trees recover very quickly, even when seriously scorched, a slight burning is no detriment, and is evidence that the work has been effective, except in the case of ‘black scale’ (*Lecanium oleæ*), during the early summer, when the eggs are under the females. The proper time to fumigate for this scale is during the fall or early winter, when they are in the larval state.

“In order to render the canvas used for fumigation perfectly air-tight, to prevent the gas escaping, the tents have been treated with a light coat of linseed oil. The great objection to the oil has been that it had a tendency to stiffen the canvas and add considerably to its weight, so a cheaper and more flexible preparation was sought. The following mixture, used by Commissioner Scott, of Los Angeles country, California, during the past season, made the tents gas-tight, and left the canvas soft and pliable. The chief essential ingredient is a supply of common ‘Prickly Pear Cactus’ (*Opuntia Engelmanni*), that grows in abundance in the southern countries of the state. It is a flat-leaf species, and parties living in sections to which it is not indigenous could have it sent in boxes. To make the cactus extract, chop up enough cactus to fill a barrel two-thirds full ; then fill up with a barrel of cold water. It should stand for 24 hours, when it will be ready for use. Do not prepare more than is required for immediate use, otherwise it will become sour and worthless. Stir well, then strain ten gallons of the liquid into another tub or barrel ; dissolve 2 lbs. of common glue, and add to the cactus extract, with sufficient yellow ochre or Venetian red to give it a good body. After thoroughly mixing the ingredients it is ready for use. Both sides of the canvas should be painted, and the dressing well rubbed into the fibre with a flat paint brush.” [It is possible that our common ‘Prickly Pear’ (*Opuntia*) might answer the same purpose. At any rate, it would be worth a trial, as plenty of material could be easily obtained here.—C.F.]

“If oil is used, the canvas should be spread out and thoroughly dried before it is rolled up, or it is liable to be destroyed by spontaneous combustion. When dry there is no danger in this.”

The above has been taken from the Bulletin of the Californian State Board of Horticulture, the information having been prepared by Mr. Craw, whose opportunities for experimenting and general knowledge of the whole

matter enables him to speak with authority on the gas tents, and their practical use for orchard work especially.

Having written to my good friend Mr. C. P. Lounsbury, Chief Entomologist in the Agricultural Department, at the Cape of Good Hope, asking for some notes on his experience *re* the cyanide treatment, this gentleman has kindly sent the following, which will be of interest to all concerned in the fruit-growing industry of Victoria :—

FUMIGATION TREATMENT FOR SCALE INSECTS.

Orchard Fumigation.—The work began two years ago in furthering the fumigation method for the destruction of scale insects on orchard trees has been vigorously prosecuted at every opportunity throughout the period covered by this report. In districts where the growing of citrus fruits ranks as a commercial industry, the endeavour has been to get the local fruit-growers' association to operate a fumigation outfit or to have a few growers unite privately for this purpose. On the conditions that these co-operative fumigation clubs consist of not less than five members, representing at least a thousand trees requiring treatment, that this number of trees be fumigated within ten months, and that the facilities be extended to non-members on reasonable terms, the Government has made each a grant of £25 towards the purchase of the initial outfit. Where co-operation has seemed impracticable, private parties have been urged and encouraged to procure small outfits for the independent treatment of their orchards.

There are now nine co-operative clubs with outfits at work, and of these eight started operations during 1898. In the sequence in which they commenced these are :—Trappes Valley (Bathurst), Paarl, Oudtshoorn, Stellenbosch, Cathcart, Kei Road (King William's Town), Ncera (East London), Graaff-Reinet, and Van Staadens (Uitenhage). The covers and most of the other special apparatus required for these co-operative outfits and for fifteen private outfits were made to order under my direction and supplied to the respective parties practically ready for use ; this step was of great assistance to all, and without the promise of it the attempt to form most of the clubs would have been a vain task. A few private parties have bought cloth and made covers for themselves as directed in letters to them, and it has been learned that some have made covers from the instructions published in my "Gas Treatment" pamphlet. Most of the fumigators depend on the Department of Agriculture for their supplies of cyanide, this being sold to them at its cost to the Government. Parties resident in the South African Republic, the Orange Free State, Natal, and Rhodesia, and such outlying parts of the colony as Namaqualand and the Transkei, have written to get full particulars regarding the treatment, and in a few instances have availed themselves of the information given them

and the offer of assistance in getting the covers made. Mention of a large outfit made up for the Natal Government is made elsewhere.

Management of Outfits.—The arrangements for the management of the different co-operative outfits vary widely, a circumstance for which this office is in large part responsible, for it was considered desirable to ascertain by experiment which of the various plans that suggest themselves prove best in practice. At Paarl and Stellenbosch, the outfits are owned by the local fruit-growers' associations and are in charge of managers with whom it is stipulated that orchards be properly treated at a fixed tariff, and that a fraction—one-third or one-fourth—of the gross proceeds be given to the association, the remainder being retained as remuneration and to pay for chemicals and labour; the charges to the general public are slightly more than to members of the association. The Kei-road, Ncera, and Van Staadens outfits are owned by small clubs, the members of which subscribed the initial costs and, in return, have free use of the apparatus. Outsiders pay Sixpence a tree treated for the hire of the outfit, and both members and non-members pay the cost of the chemicals used and for the services of the manager. The members of the Cathcart club contribute One shilling for each tree they desire to treat, to cover outfit expenses, and pay for the chemicals at cost. They altogether dispense with management expenses, each farmer attending to the treatment of his own trees after receiving instruction in the use of the apparatus from the honorary secretary of the club, a medical practitioner. This plan has thus far been the least satisfactory of the several described, a paid manager seemingly being a necessity. The Trappes Valley people raised the initial fund by a subscription list. They pay a manager Twelve pounds a month, and treat trees at a charge which covers the cost and allows for a renewal of the outfit (see appendix). The subscribers had the first use of the apparatus, but have had no other advantage over outsiders. Oudtshoorn has the most business-like arrangement. The whole fumigation plant is the property of the fruit-growers' association, and was paid for by the membership fees. Members' trees only are treated, but residents of the district may easily become members. The trees are treated at tariff rates and, while these are high, there is no cause for complaint, since any surplus over expenses is association property. The manager is paid Twelve pounds a month, and is allowed a saddle horse.

All of the clubs depend upon the farmers for the transport of the apparatus to or from their orchards. The Oudtshoorn association owns a special waggon, but with this exception the clubs depend on the farmers for both vehicle and draught animals. Except at Oudtshoorn, dependence is also placed on the farmers for two or more boys to help with the work, and in several cases he is required to board and lodge the manager without charge.

Cloth for Fumington Covers.—The covers for the early outfits were made of eight or ten ounce American cotton duck of the best quality, and were lightly coated with a mixture of one part turpentine to four

of linseed oil. Sometimes raw oil was used and sometimes boiled ; there appeared to be no great difference in result, but if more covers were to be oiled preference would be given to the boiled. Raw oil without turpentine was applied to a number of covers ; exposure to the sun for several weeks was required to dry these, and then the cloth was found to be not only stiff but very weak, slow combustion apparently having taken place. The oiling of the covers increased their weight by two-thirds without, of course, adding anything to the strength, besides it invariably stiffened the fabric to some extent, thus making it less easy to handle, and more likely to tear. These objections to oiling the cloth might not be serious if the covers were always to be used on well-grown trees, and by experienced hands ; but they proved decidedly serious where the covers were employed in treating misshapen, long neglected trees by parties with little or no previous experience. Our need was soon clearly seen to be covers combining the maximum of strength and pliability with the minimum of weight. The necessity led me to experiment with unoiled covers of heavier cloth, and after several weights were tried, what is known as No. 10 American duck was adopted for large covers, and No. 8 for small ones. For several months, however, the lighter cloth, No. 10, has been used for both large and small sizes. Different brands of this cloth are sold, but only the most closely-woven ones are adapted to our purpose. It weighs between fifteen and sixteen ounces to the square yard, and after it is well shrunk with water no interstices should be apparent when it is held between the eye and the sun. The sewing is done by machine with Singer Company's linen thread, single seam for tent covers and double for sheets ; a short stitch is advisable, and No. 45, or heavier thread, should be used for the sheets. It was found difficult to manipulate sheet covers of oiled cloth fifty feet in diameter, but even new hands have had no trouble in managing fifty-seven foot sheets of No. 10 duck unoiled. In only one respect are the oiled covers superior to the stronger and more durable unoiled ones, and that is with respect to their gas-retaining properties. The gas escapes through even the oiled cloth, but much more rapidly through the unoiled, even though the latter appears equally tight to the eye. Despite of this effect, however, covers of the unoiled heavy cloth have given far greater satisfaction and will probably continue to be used. But observation of the results obtained by use of the customary dose of one ounce of cyanide to 300 cubic feet of enclosed space (for red scale) has convinced me that allowance must be made for the loss of gas by diffusion through the covers. It is observed that the proportion mentioned cannot be relied on to destroy all the scale on small trees when the unoiled covers are employed. A larger dose is advisable even under heavily-oiled covers, while for use with the unoiled, I am of opinion that the proportion should be gradually increased from one ounce to 300 cubic feet for a tree sixteen feet in height, to one ounce to 125 cubic feet for a tree six feet in height. The surface through which the gas escapes increases

in proportion to the space enclosed as the dimensions of the tree decreases; hence the necessity for giving small trees proportionately greater doses. There is more than four times as much surface to the space encompassed by the cover in the case of a 4' x 3' tree than there is in one 16' x 12'. When trees are dosed with the quantities of chemicals recommended in the old tables, there is little odour of the gas under the two smaller sizes of tent-form covers forty minutes after the reaction has taken place, while under the large sheets it is often disagreeably strong ninety minutes after, thus clearly demonstrating the error of basing the table of quantities on the cubic contents alone. A number of covers of a Willesden rot-proof and water-repellant duck of the same weight and quality as the ordinary No 10. duck have been tested, and have been found to better retard the permeation of the gas, though not to a very marked extent. The cloth was less easily sewed than ordinary duck, and its odour of ammonia when handled in the making gave much annoyance to the parties who sewed it. The naturally green colour faded quickly under the action of the cyanide fumes. It is yet too early to decide definitely whether or not it is preferable to the ordinary cloth in the long run. The cost in London was about equal to what is paid for the other in Cape Town. Several parties are using covers of oiled unbleached calico and express themselves well satisfied. Dressing a cover with fat, as waggon sails are waterproofed, was tried by the manager of the Oudtshoorn outfit and found inadvisable; the dressing never dried and soon weighted the cover with an accumulation of adhering soil and rubbish.

Manipulation of Sheet Covers.—The style of uprights for raising and lowering the sheet covers described in the "Gas Treatment" pamphlet is still employed, but the long poles are now tapered from $2\frac{1}{2}$ " x 4" at the base to $1\frac{1}{2}$ " x 4" at the top, and are twenty-six feet in length, and the braces are cut six feet instead of five; a simpler device finds a few champions among orchardists working with a single sheet. The idea is to gather half of the sheet in loops of rope and by means of poles as levers to raise this gathered half until it is directly above the tree to be covered, while the loose half hangs to the ground; then to slaken the loops and thus permit the suspended folds to open and fall forward. Two long light poles, pointed at the base and at least three feet higher than the tallest tree to be covered, two pulley blocks, and a quantity of rope is all the apparatus required. Two small holes, about the width of the trees apart and in line with, and equally distant from the centre, are cut in the sheet; the tops of the poles are passed a few inches through the holes and are bound securely in this position; one end of a long rope is then fastened to the projecting top of the pole, and the other passed out around the margin of the sheet back to the pole beneath the hole, and through a pulley block there secured. When these tackle ropes are adjusted to both poles, half of the sheet lies in two loops, and hauling on the free ends of both ropes contracts

the loops and thus draws the half of the sheet into folds. One or two guy ropes are attached to the tops of the poles to assist in raising and lowering them. Preparatory to covering a tree, the sheet is spread out and the half of it toward the tree gathered into folds as described; the poles are laid parallel, one at each side, with the feet in line with the trunk and braced in some manner to prevent their slipping. Four men are required to raise the cover, two for each side; one lifts the pole while the other with a guy rope assists him and works to prevent the pole slipping to one side. To relieve the strain on the cloth, it is customary to connect the tops of the poles with a rope a few inches shorter than the width of cloth between them. When the cover is in a position over the tree, the poles are, of course, beneath. This manner of manipulating the cover was first practised by Mr. W. E. Murray, of the Graaff-Reinet district, and by him explained to me. I found him covering trees fully eighteen feet high, using dried flower stalks of American aloe (*Agave americana*) as his poles.

Generating Dishes.—China pudding-basins are now substituted for the lead dishes first used as generating vessels. They are much less costly and are preferable on the score of lightness; also the smooth and rounded bottom inside is in their favour, it tending to keep the cyanide floating in the acid during the reaction and thus rendering its complete decomposition most probable. The bottoms of lead dishes soon become battered and flattened; under this condition lumps of cyanide may become stranded when the acid is shallow and the dissolution thereby checked.

Extent of Orchard Fumigation.—The aggregate number of orchard trees treated during the year by the fumigation process is known to be above 24,000 and may be as high as 27,000. This is a large number for the Cape when it is considered how small, scattered, and of uneven growth our orchards are, and that the treatment is in its infancy with us. The Trappes Valley Club reports that it fumigated 8,678 trees in fifteen months in 22 orchards; and the Oudtshoorn Club 4,127 in 110 orchards in ten months. Satisfaction is everywhere expressed with the results, and some of the unsolicited statements as to the success of the treatment are more flattering than patent medicine testimonials. The fear that the scale would soon render the growing of citrus fruits unprofitable has passed away.

Fumigation of Deciduous Trees.—The employment of fumigation to destroy scale insects on deciduous trees has not been specially recommended, since these trees may be sprayed thoroughly during the winter with efficacious washes at a relatively lower cost. But fumigation may sometimes be advantageously substituted for spraying in the case of deciduous trees. If the treatment is performed during the winter, it may be carried on during cool days under darkened covers without injury to the trees, and doses strong enough to destroy all stages of even egg-laying species safely administered.

Nursery Fumigation Chambers.—The example set by the curator of the Grahamstown Gardens, and by Mr. Henry Meyers, of the Fernwood nurseries, Newlands, in providing facilities for the fumigation of nursery stock—to which allusion with illustrations was made in last year's report—has been followed by Mr. H. E. V. Pickstone, of Groot Drakenstein, Messrs. Gowie Brothers, of Grahamstown, and by the curator of the Graaff-Reinet Gardens. The two latter nurserymen have erected brick vaults very similar to the one at the Grahamstown Gardens. Other nurserymen have promised to have chambers ready for use at the commencement of the selling season. All our nurserymen should be provided with fumigation chambers, not only for the treatment of stock being despatched to their customers, but that they may ensure the destruction of any scale insects which might infest stock received by themselves, either from abroad or from other South African nurseries, and also for the disinfection of scions and cuttings. If root cuttings of apple were fumigated before being grafted upon, many of our nurserymen would be spared much of the annoyance caused them by the woolly aphid.

Experiments to ascertain amount of Cyanide required.—There is room for considerable investigation in ascertaining the amount of cyanide to a given space necessary to generate sufficient gas to destroy different insects exposed in an air-tight chamber such as nurserymen would use, and if an opportunity presents itself, a little work along the suggested line will be conducted during the present year. A few experiments performed last year brought out some interesting facts. In an approximately air-tight closet, the gas from one ounce of cyanide to 750 cubic feet in two hours failed to appreciably affect adult scale insects, but destroyed fully 95 per cent. of woolly aphid on stems of apple. One ounce to 450 cubic feet for one hour appeared to be fatal to the red scale in all stages and to all but the eggs of the oleander scale (*Aspidiotus nerii*), white peach scale (*Diaspis amygdali*) and greedy scale (*Aspidiotus camellie*). The same strength for two hours did little more. One ounce to 300 cubic feet for one hour proved fatal to all stages of the species named and to the eggs of an oleander-infesting mealy bug (*Dactylopius sp.*), but a few of the adult mealy bugs survived an hour's exposure in one ounce to 200. When any of the species used in the experiments was much massed on the infested surface, the destruction was strikingly less thorough than when the scales occurred singly. A few adult females of the greedy scale in a mass of their kind on the fruit of a large-fruited *Solanum* (*Solanum aculeastrum*) failed to succumb when exposed for an hour in one ounce to 300, while not one among many hundreds of scattered individuals lived through an hour of one ounce to 450. Similarly some larvæ of the oleander scale sheltered in the scurf of old scales of its species on American aloe (*Agave americana*) survived one in 300. These observations confirm what has been suspected with respect to orchard fumigation, that a dose fatal to every scale insect on moderately-infested trees sometimes proves

insufficient in a very badly-infested case by an occasional scale escaping through the protection afforded by a covering of other scales. A diligent search shortly after the treatment has often failed to reveal the presence of a single survivor among thousands of dead scales, but that a few had escaped the general destruction would become apparent after the laps of three or four months. The decreased potency of the gas as it penetrates masses was prettily illustrated by its action on the eggs of the Australian bug (*Icerya purchasi*). This scale insect, be it remembered, deposits a very large number of eggs in a sac-like outgrowth from the posterior of its body, and the eggs within this ovisac are embedded in a mass of protective cotton-like filaments. Comparatively weak gas destroyed the eggs nearest the end of the sac, but had no effect on those further within. As the doses were increased in successive tests, larger and larger proportions of the total number succumbed, but those in the layer immediately against the body survived even one ounce of cyanide to 200 cubic feet, and a very few in the largest sacs withstood even a half hour's exposure of one ounce to 150 cubic feet. A number of young apple trees badly infested with woolly aphis were exposed to the gas after sousing the roots in water to remove the soil. One ounce to 450 cubic feet for one hour appeared at the time to be thoroughly efficacious, but after the lapse of three months the roots of even those exposed to one to 300 for an hour and of those to one to 200 for a half hour were again much infested. The film of water about the roots or the traces of soil still clinging to them had evidently served to protect a number of the insects. Altogether, the series of tests, though incomplete, indicates that in the disinfection of nursery stock care should be taken to give the gas free play among the trees, and that it is advisable to employ much stronger doses than what are known to be fatal under ordinary circumstances. Dormant deciduous stock is not injured by exposure to four times the normal orchard proportion for citrus trees—one ounce to 300 cubic feet. The cost of charging a small chamber is a mere trifle, and, this being the case, my present recommendation to nurserymen is to use not less than one ounce to 125 cubic feet of space when treating deciduous trees. The strength which citrus trees will stand without being injured has not been determined, but fully dormant stocks are not injured in the least by one ounce to 250, nor more than the tips of growing trees by one ounce to 300; under favorable conditions at least, the latter portion is fatal to all stages of the scale insects known to affect citrus stock in the nurseries of this colony, with the exception of the Australian bug and mealy bug.

Hydrocyanic Acid Gas for Glasshouse Fumigation.—An officer of the United States Department of Agriculture has been experimenting off and on for the last four years with hydrocyanic acid gas as an insecticide for the destruction of various kinds of insect pests which affect plants in glass houses, and following his lead a number of gardeners have adopted this fumigant. It is said that it has been found possible to destroy practically every insect without injuring so much as a leaf or

flower. Even mealy bugs and *Orthezia insignis* are said to be destroyed without the least injury to so delicate a plant as coleus. A description of the process, taken from an American source, was published in the *Gardener's Chronicle* for 16th July last, and from this I glean the following particulars :—Three parts of acid to two of boiling water are used, and the cyanide added while the acid-water mixture is bubbling with heat ; this secures a very rapid evolution of the gas, and necessitates the use of a large generation vessel to prevent slopping over the sides. The exposure is a short one, the house being opened as much as possible from outside as soon as twenty-five minutes have expired. For each cubic foot of free space enclosed, one and eight-tenths grains of cyanide are used ; which, if troy grains are intended as seems most probable, is equivalent to one avoirdupois ounce to 200 cubic feet. “All damp must be driven out of the house, and the plants should be quite dry in their foliage before commencing to fumigate them with the cyanide, because if there is any moisture on the leaves and young growths, they are liable to get scorched. All being dry and in good order, the process may be carried out with perfect safety to the plants ; and houses full of palms, ferns, roses, violets, carnations, and other tender plants and flowers have been treated as described with the most successful results, the insects being destroyed and neither a flower nor a leaf hurt in the least.”

To what extent this innovation in glass house fumigation has come into practice I do not know, but its discussion in several gardeners' papers has attracted wide attention to it. Opinion concerning its practical value is diverse, largely on account of the risk both to the operators and the plants ; but there seems to be no question that when certain precautions are fully observed the results will be all that is claimed above. However, I do not refer to the use of the gas in glass houses here in order to recommend its general adoption in this country. I am not prepared to do that, not having experimented to satisfy myself just what precautions are necessary to ensure entire safety to the plants. But I do suggest that nurserymen and florists who have fumigation chambers, and gardeners who have closets or rooms they could safely use as chambers, experiment on pest-ridden plants to which they can afford to risk injury, and demonstrate to their own satisfaction the economy of the process. The essential feature to prevent injury to the plants seems to be the absence of moisture, both in the air and on the foliage. Our climate is so mild a one that it is unnecessary to have glass houses here built and kept in such good repair that they are approximately gas-tight ; and it naturally follows that the proportion of them which may be closed tight enough to answer as fumigating chambers is not large. Further, owing to the exceedingly poisonous character of the gas, its use in conservatories attached to dwellings is dangerous. For these two reasons it is unlikely that the gas will become a popular glass house fumigant in the colony. Still, florists, curators of public gardens, and gardeners on large estates may find its use, particularly in special chambers, a welcome improvement on their

present methods of dealing with scale insects and aphides on house plants.

Hydrocyanic Acid Gas for Dwelling Fumigation.—I mention the subject principally to condemn this dangerous practice. It has been suggested, not unnaturally, by the highly successful results obtained in destroying orchard pests by the gas. Almost needless to state, the chief intent of house fumigation is to effect the destruction of that unmentionable, but in this colony by no means uncommon, insect, which is recognised in scientific circles by the appellation *Acanthia lectularia*. The gas, when used at double the strength for orchard treatment, does have a most beneficent effect on the creatures, but it does not often accomplish a complete riddance. The construction of most colonial houses is too faulty for thorough work, currents of air entering crevices and diluting the gas in them to a degree at which it is not deadly ; by virtue of this, a few of the vermin or their eggs are tided through the deadly visitation to their mates. Extermination being improbable, there is little to induce one to give this remedy preference over less dangerous measures, and I think that parties, other than experts, who know just what risks are assumed, and what to do in case of an accident, are wholly unwarranted in employing it. Even experienced hands had best avoid its use under ordinary circumstances. Hydrocyanic acid gas is not a poison to trifle with, and as a warning to those whose enthusiasm over its unrivalled insecticidal properties leads them to meditate its use in their dwellings, I invite their consideration to the fact that I have learned of several instances within the last year of parties having narrowly escaped death when such use was being made of it. The danger is not in the generation of the gas, but in the subsequent opening of the rooms for ventilation, and in the risk of parties entering the rooms unawares during the operations or too early after they are over. The danger attached to orchard fumigation or the use of the gas in special chambers is infinitesimal in comparison. In connexion with these uses of the gas, I have not heard of a single accident occurring in this country, and only one, a temporary prostration due to deliberate disobedience, in America.

In Part I. of our Handbook several pages are taken up with descriptions of the various kinds of fumigating apparatus, as also illustrations of same, these having been taken from American publications. As a ready means of combating scale on trees, especially those of the citrus family, large deciduous trees being much more difficult of treatment by the gas tents, the cyanide treatment has much to recommend it, the principal objection, according to the best up-to-date American experts, being the matter of cost.

In Victoria but little has been done in the way of the cyanide system of fumigation, although at the Burnley Gardens a complete plant is working—this only for trees and plants which are imported from the neighbouring colonies or from outside.

The Burnley fumigator is a wooden building, lined with felt and then papered, the cyanide being introduced for safety's sake from the outside of the building, so that there is no danger to be apprehended from suffocation, the effects of inhaling the gas during fumigating operations. Near the floor of the room is a "turbine fan," this being worked by water, so that when the time of enclosure has expired the cap of the tall flue is opened by means of a lever, the water turned on, and the building in the course of a few minutes may be opened with safety, and the trees removed to make room for another lot which require similar treatment.

Every nursery in the colony which sends out trees for sale should, in my opinion, be compelled to have a small fumigator erected on the place, so that all stock to be packed should be first treated by means of the cyanide chamber. It need hardly be pointed out to any practical man that it is from nursery stock far more than from fruit that the great danger of introducing many diseases lies, as with fruit the chances of escape from infection are many, but with trees you plant your orchard and at once establish the disease, be it fungus or insect, on a permanent basis. With regard to the fumigation of fruits imported into Victoria, I must admit that I am against such a course, for the reason that growers who send their fruits here should be compelled by law to send it free from disease or not at all. I hold it to be unfair to our own growers, who are compelled by the terms of our Vegetable Diseases Act to keep their orchards clean and free from disease, and to erect fumigators, would, in my opinion, tend to render our colony a dumping ground for diseased fruits of other countries.

It has been proved beyond all doubt, in the case of oranges and lemons which are exported to Victoria from Messina and other places in Europe, that by rejecting all diseased and scale-infested fruit we are only doing justice to our own growers, as each year, owing to careful supervision on the part of our inspectors, the fruit so imported is showing a marked improvement, whereas, were fumigation at our port permitted, we would have the same tale to tell of dirty foreign fruit being sent here as before. In closing these few remarks *re* the fumigating of trees and fruit by the cyanide process, it may be mentioned, on the authority of our Vegetable Pathologist, also upon the testimony of other gentlemen whose opinions cannot be doubted, that the fumigation of trees by the above-mentioned process has no perceptible effect upon diseases of fungous origin. In Victoria we have had but little experience with the cyanide treatment as practised under canvas, but as all the information regarding the gas-tents, &c., is well understood, and as the tents can be made here, there would be little or no difficulty in the way of a commencement being made on the co-operative system as practised in America and elsewhere.

APPENDICES.

ILLUSTRATIONS OF SPRAY PUMPS AND OTHER MACHINES IN USE FOR THE DESTRUCTION OF INSECTS.

The object of including in Part III. of the Handbook illustrations now in use either here, Europe, or America is that farmers, fruit-growers, vigneron and others may be able by aid of figures and descriptions to select for themselves such articles as appear best suited for their requirements; and as our rural population is in some districts scattered and so far from the great centres of population, I have thought it advisable to furnish some particulars as to cost, &c., as also the names and addresses of firms from whom the machines may be obtained, taking them in the order in which I have received the particulars from the owners or their agents; the author of each article or description being responsible for the statements contained therein.

APPENDIX I.

SPRAY PUMPS, ETC.

THE DONCASTER SPRAY PUMP.

(See Fig. 1.)

These pumps are made in three sizes, viz., 1½-in., 2-in., and 2-in. double action. These sizes are the diameters of the solid gun-metal plungers, of which material the pumps are constructed, and are mounted on 50 and 80 gallon vats. They are fitted with large air chambers, which enables them to keep up a powerful and continuous spray. For the handle a balance lever is used weighted at one end. They can be easily worked by a boy. The spray directors consist of long tubes with wheel valves at the lower end, so that the spray can be turned off instantaneously without lowering the nozzle. The pumps are fitted with the Davies Patent Agitator. The object of this agitator is to provide a device which will effectually agitate the liquid

contained in the spray vat, by the movement of this agitator the whole of the contents of the spray vat is maintained in a thorough state of agitation. This agitator has three blades semi-rotating on a stud arm on the suction pipe. There are thus formed in the vat a back-wash and a by-wash, which effectually cause all the ingredients to be assimilated. Williams' Patent Kerosene Attachment is fitted to nearly all Doncaster Spray Pumps now made, as this improvement is now recognised as the best improvement yet made in connexion with spray pumps; it is simplicity in itself. The attachment consists of a brass tube, one end of which is screwed into a cheek and wheel valve at the side of the pump; the wheel valve is to regulate the supply of kerosene. The other end of the tube is bent round and inserted into a vessel containing kerosene, which is fixed on the side of the vat. By this means kerosene and water are pumped up at the same time, and by the action of the plungers become thoroughly amalgamated under pressure. The attachment can be detached from the pumps when not required, or may be used in connexion with other mixtures. We may mention that all valves, &c., are on the outside of the vats, and can be examined readily. The kerosene can be regulated to any desired strength. Bucket spray pumps can be fitted with the patent kerosene attachment also.

Price: £10; kerosene attachment 30s. extra.

John Davies and Co., 235 Franklin-street, Melbourne.

PUMP FOR PARKS AND GARDENS.

(See Fig. 2.)

SMALL HANDY PUMP, WITH KEROSENE ATTACHMENT, THROWING A TRIPLE SPRAY, FITTED WITH PISTON PLUNGER AND GUN-METAL VALVES.

(See Fig. 3.)

SMALL HANDY PUMP, WITHOUT KEROSENE ATTACHMENT, FITTED WITH LEVER HANDLE.

(See Fig. 4.)

DAVIES' PATENT AGITATOR.

(See Fig. 5.)

The object of our new agitator is to provide a device which will effectually agitate the liquid contained in the spray vat. By the movement of our agitator the whole of the contents of the spray vat is

maintained in a thorough state of agitation, with the result that all the ingredients are held in suspension in the mixture, and pass out through the spray nozzles thoroughly mixed.

The action of our new agitator is as follows:—There always being at least one or more of the blades in the liquid, the pump lever when in operation causes the said blades to rotate on the stud arm. There are thus formed in the vat a back-wash and a by-wash, which effectually cause all the ingredients to be assimilated.

The agitators can be placed anywhere on the suction pipe simply by adjusting a set screw. The blades can be either corrugated or plain; and also can be set at any angle required.

Price: 12s. 6d.

John Davies and Co., 235 Franklin-street, Melbourne.

THE DANKS "CHEE" PEST SPRAY PUMP.

(*See Fig. 6.*)

This is a registered design spray pump, admirably adapted for small orchards and gardens. The cylinder is brass, and it has gun-metal check valve, brass air chamber, and iron foot stirrup. It is fitted with 4 feet of suction hose and brass strainer, along with 3 feet of delivery hose, director, and single spray. It is capable of working four sprays continuously, and without doubt is the best small spray pump yet introduced.

Price: £1 12s. 6d.

John Danks and Son Proprietary Limited, 391 Bourke-street.

THE DANKS IMPROVED ACME SPRAY PUMP.

(*See Fig. 7.*)

This engraving represents the Danks Acme Spray Pump, to which we have given a great deal of attention. This sprayer is suitable for medium-sized orchards and vineyards; the carriage is strongly made and the cask is firmly fixed to it and well placed, the wheels are of large diameter, and the flanges are wide so as to travel easily over soft or friable soils. The pump, which is made of gun metal, with valves of the same material, is on the semi-rotary principle, it is fitted with an air chamber of good capacity, and is capable of supplying a steady and continuous spray through two treble sprays. This spray pump is fitted with two 15-ft. lengths of hose of good quality. The disturbing arrangement, which is the outcome of many experiments, is simply perfect. The movement, the action of which is shown in the accompanying sectional engraving, is gained from an extension of the pump spindle, to which is connected the cross arms; a rod hangs from the extremity

of each of the cross arms to the dasher below, to which it gives a cradle motion, thus moving the solution throughout at each motion of the pump handle. The working of the disturber entails a little extra labour, but it does not at all effect the pressure at the sprays. The improved strainer is fitted, as shown in sectional view of the Challenge. It is made of brass gauze, and the mesh is fine so as to prevent small crystals or foreign matter from entering the pump, and thus choking the sprays. The spray caps are movable so as to allow of the easy removal of foreign matter should any possibly find its way there.

Price : £14.

John Danks and Son Proprietary Limited, 391 Bourke-street.

THE DANKS CHALLENGE SPRAY PUMP.

(*See Fig. 8.*)

The Challenge Spray Pump is exactly the same in detail as the Deluge Spray Pump, but is of smaller size throughout. We have brought this pump out mainly for orchardists and fruit-growers, for whom the Deluge Pump is too large, and many of our other pumps too small. We have spared no effort to make this pump a thorough success, and the appreciation that it has already been met with is sufficient proof to us that our efforts have not been in vain. It is fitted with two lengths of hose, each 15 feet long, with treble sprays. Cocks are provided on the air chamber, so that either one or both hoses may be used at the same time. The pump is made of hard gun metal, with gun-metal valves ; it is of the double-action type, so that the spray is continuous ; it is fitted with a proper-sized copper air chamber. The suction pipe is of copper. Our improved cradle agitator is fitted to this pump, the motion being given by every movement of the handle by means of rods connected to cross arms firmly fastened to the spindle of the pump. It is also fitted with a large brass wire gauze strainer for straining the liquids. The capacity is about 30 gallons.

Price : £10 10s.

John Danks and Son Proprietary Limited, 391 Bourke-street.

KNOWLES' VICTORIA SPRAY PUMP.

(*See Fig. 9.*)

This pump—an improvement on the Excelsior—is now made with a galvanized wrought-iron lever handle, which greatly increases its power and ease in working. It will be appreciated by those who have up to 5 acres of fruit trees under cultivation. It is fitted with a cover,

and has a dasher agitator which will thoroughly mix all spraying compounds. A newly-designed metal ring grip of improved construction has been added, so that the pump can be removed from the pail and refixed in a few seconds. It is perfect in every respect, and guaranteed to give satisfaction.

The Victoria is of the best construction and workmanship. Being manufactured entirely of brass and gun metal, it is not injuriously affected by corrosive solutions; nevertheless it is advisable that the bucket be rinsed out, and fresh water passed through the pump after each day's spraying. It is supplied with 6 feet of the best quality hose, an 18-in. galvanized-iron delivery pipe, stop cock, agitator, and improved Triumph Spray Nozzle.

Price: Complete as shown, in 5-gallon drum, £2 15s.; in 10-gallon drum, £4.

Geo. Knowles, Hardware Chambers, 231 Elizabeth-street, Melbourne.

KNOWLES' ORCHARDIST SPRAY PUMP.

(See Fig. 10.)

This old favorite has been much improved for the present season. It will be found equal to the requirements of those fruit-growers and vignerons who cultivate from 15 to 30 acres. The outlets have been so arranged that (by means of a loose cap which is sent with each pump) it may now be used with a single delivery if so desired, and if purchased as a single delivery it can at any time be converted into a double delivery at a cost of £1 for hose, delivery pipe, stop cock, nozzle, and union connexion.

As shown in the illustration, the Orchardist is fitted in a strong oak cask (holding 40 gallons) on a stand, and is furnished with two 15-ft. lengths of best quality rubber hose, two 36-in. delivery pipes, with stop cocks and patent Triumph Nozzles (which can be used either on 18-in. or 36-in. lengths), an improved ring grip (which securely fixes the pump in the cask, yet allows of its removal in a few seconds), a dasher agitator, and a copper strainer measuring 5 x 5 x 5. Both valves are accessible, and may easily be removed if necessary.

Price: Single delivery, without cask, £4 10s.; double ditto, £5 10s.; single delivery, with cask and copper strainer, &c., £6; double ditto, £7.

Geo. Knowles, Hardware Chambers, 231 Elizabeth-street, Melbourne.

THE TRIUMPH SPRAY NOZZLE.

(See Fig. 11.)

Numerous spray nozzles have from time to time been brought under the notice of fruit-growers, all of which have, more or less, defects in their construction.

The chief of these is their liability to choke, and the difficulty and loss of time in removing the obstruction.

The patentee of the Triumph does not claim that he has invented a nozzle which will pass half a brick without its choking; but he guarantees that any obstruction which may find its way into it can be more easily and quickly removed than from any other.

Should the centrifugal mechanism inside the nozzles be lost it can be replaced at a cost of one farthing, and every one using it should carry a few in his pocket.

The Triumph throws a large amount of fine spray at the smallest expenditure of solution, and will therefore soon save its cost.

It will convert into spray from 1 to 4 pints of solution per minute, according to the size of the outlet.

Price: Single, 5s.; double, 7s. 6d.; revolving (single), 7s. 6d.; revolving (double), 10s.

Geo. Knowles, Hardware Chambers, 231 Elizabeth-street, Melbourne.

THE CHAMPION.

(See Fig. 12.)

The Champion is on the horizontal principle, with piston, and is made entirely of brass.

The cylinder is fitted to frame on an axis, which prevents any strain on the piston rod.

The valves are of brass, and can be removed by unscrewing cap over each.

It cannot possibly get out of order, and the packing around piston is kept tight by a regulating screw.

It can be taken to pieces in a few minutes, thus preventing the necessity of sending for repairs, also avoiding the freight to and from Melbourne.

Sufficient power to supply two or more hoses fitted with quadruple sprays is easily obtained by the lever, to which is attached an agitator, which keeps the liquid thoroughly mixed.

Price: Fitted with two hoses, each 15 feet long, with 6-ft. directors and stop taps, and quadruple sprays to cask, £8 15s.; without cask,

£8; if fitted to 40-gallon vat, wide at bottom, £9 10s.; 60-gallon ditto, £10. Hoses and directors can be made any length. Hose, 6d. per extra foot. Director, 2d. per extra foot.

T. McAlpine and Co., 98 Flinders-street, Melbourne.

THE CHALLENGE.

(See Fig. 13.)

The Challenge is specially adapted for small orchards; is very strong, powerful, simple, and compact. It is fitted with lever and worked by one person, and fitted to frame with wheel $2\frac{1}{2}$ inches wide. It supplies a long-felt want, being easily moved about.

The pump is made entirely of brass, and the valves can be easily removed; it cannot get out of order, and any person can repack it, thus saving any cost for repairs. It can be detached and packed in a small space for transit.

Price: 4 feet best hose with 4-ft. director, stop tap, and quadruple spray—with lever attachment, £4; with handle, £3 10s. The Challenge can be had fixed to cask with lever attachment, 15 feet hose, 4-ft. director, stop tap, and quadruple spray, £5 5s. An agitator is attached to the lever.

T. McAlpine and Co., 98 Flinders street, Melbourne.

UNSWORTH'S PATENT SPRAY PUMP.

(See Fig. 14.)

A new departure in Spray Pumps.—The pump requires no attention during spraying when once the air chamber is pumped full, and will, with an ordinary jet, keep up a continuous spray for ten minutes. It consists of two cylinders, one over the other, the top cylinder being air-tight, in which the liquid from the bottom cylinder (or tank) is pumped; thus, having a large air pressure, an even and continuous spray is kept up. A boy could manage it.

Made in galvanized iron or copper, with gun-metal valves.

Price: Without sledge, in galvanized iron, £5; in copper, with wood tank, £6 10s.; holds 15 gallons. Larger sizes to order.

W. Unsworth, 58 Little Latrobe-street.

APPENDIX II.

INSECT AND BLIGHT DESTROYERS.

LEWIS AND WHITTY, 339 Flinders-lane, Melbourne.

Resin Wash.—In liquid, 20 times concentrated, for the eradication of aphid blight, red spider, mussel scale, &c. This liquid is soluble in cold water.

Kerosene Emulsion.—In liquid, 20 times concentrated ; soluble in cold water. A perfect blending with this oil and water, dispensing with separate attachment for spraying.

Benzine Emulsion.—In liquid, 20 times concentrated ; soluble in cold water ; kills by contact ; benzine evaporating, leaving emulsion in the shape of resin wash upon the tree.

Benzole Emulsion.—In liquid, 20 times concentrated ; soluble in cold water ; this also kills by contact ; highly recommended for Rutherglen bug ; benzole evaporates, leaving resin wash behind.

Turpentine Emulsion.—In liquid, 20 times concentrated ; kills every insect it comes in contact with, without injury to the tree ; soluble in cold water.

Hellebore Mixture.—Fifteen times concentrated ; for pear slug.

Grasshopper Preventative.—Fifteen times concentrated.

WM. ADAMSON AND CO., Seedsmen, &c., Elizabeth-street,
Melbourne.

Blight Cure.—A preparation of tobacco destroys all insects, bugs, slugs, &c., attacking fruit trees, vines, flowers, or vegetables, either on the leaf or at the roots. Half-pint bottle, to make 5 gallons, 1s. 6d. ; pint bottle, to make 10 gallons, 3s.

Fir-tree Oil.—Effectually clears all insects and parasites from the roots and foliage of trees, vines, and plants. Kills all grubs, flies, &c. Cures mildew and blight, and makes a good winter dressing. In bottles, 2s. and 3s. each.

Gishurst Compound (patented).—One of the oldest and best insecticides yet introduced for destroying all kinds of insect life. 1-lb. boxes, 1s. 6d. ; 3-lb. boxes, 4s. ; 12-lb. boxes, 14s.

Hellebore Powder (English).—Very useful for destroying pear and cherry slugs, worms, caterpillars, slugs, &c. In tins, 1s. 6d. Cheaper in quantity. Directions for use.—In solution—Dissolve 1 oz. in 3 gallons of water, and apply with syringe or pump. Dry application.—It may be used alone, but it is better mixed with flour or powdered lime at the rate of 1 lb. to 4 lbs., and dusted on with bellows.

Lethorion Carbon Cones.—For the purpose of destroying parasitic life by vapour. 9d., 1s., 1s. 6d., and 2s. 6d. each, with directions for use.

Nicotine Soap.—An unrivalled preparation for destroying insect life upon plants without injury to the foliage. In jars, 1s. 9d. and 3s. 6d. each.

Pestide Compound.—A safe and effectual remedy for insect and fungoid pests. Snails and slugs are easily destroyed and eradicated by it. Mixes with cold water, no sediment, and is easily applied. 10-oz. bottles, making from 3 to 5 gallons, 1s. each.

Nikoteen.—A preparation containing about 30 per cent. of nicotine. For all kinds of scale, aphids, and codlin moth; it is very effectual, and is easy to use. In bottles, making from 5 to 6 gallons of spray, 9d. each; 10 to 12 gallons, 1s. 6d.; 20 to 25 gallons, 2s. 3d.; 80 to 100 gallons, 6s.

Paris Green and London Purple.—Poisonous; insoluble powders, excellent for destroying codlin moth, caterpillars, and all kinds of insect life. 1s. 6d. per lb.

Paris Green Paste (Blundell's Pure).—Ready for use. 1s. 6d. per lb. bottle.

Quibell's Insect Exterminator.—Is very effectual for insects on cabbages and all vegetables, flowers, or plants, red spider, mildew, &c., &c. In bottles, 1s.; gallon tins, 7s. each.

The Bradbury Insect Exterminating Fluid.—For scale, blight, fungoid pests, rust, mildew, oidium, aphids, and all insect pests. In tins, 1s. 6d. each.

Tobacco.—For fumigating. 1s. per lb.

Tobacco Juice.—This tobacco juice contains the strength of 42 ozs. of Virginian leaf tobacco to the gallon. For destroying insects of all kinds. In jars, 1s. 6d. each.

Tobacco Powder.—Kills green and black fly, &c., if dusted or blown on the foliage while moist. In tins, 1s. 6d.

G. KNOWLES, Hardware Chambers, Elizabeth-street, Melbourne.

"Kilemquick."—This is a pure vegetable extract, and is one of the most deadly insecticides known to science. It will kill all insect pests which can be destroyed by spraying. It has been thoroughly tested by hundreds of Victorian fruit-growers and proved to be deadly effective against peach and all other aphides, larvæ of codlin moth, mussel, orange, lemon, and all other scales, pear and cherry slug, Rutherglen flies, caterpillars, mealy bug, thrip, cabbage-fly, &c. It is guaranteed to be harmless to the most tender shoots and to all foliage, and to be an invigorating fertilizer.

Five gallons, sufficient to make 800 gallons of strong spraying solution, costs 20s., iron drums 1s. extra. It readily mixes with cold water, needs no preparation, and is available at once when required. A special

item in its favour is that it does not render the pump unworkable by sticking the valves fast, and it does not choke the spray-nozzles. Pints 1s., $\frac{1}{2}$ gallons 3s., gallons 5s., 5-gallon drums 21s.

J. A. FERGUSON, Batman's Chambers, 489 Flinders-lane, Melbourne.

"*Spimo*" is the name of a liquid plant wash manufactured by Messrs. E. A. White Ltd., hop and fruit growers, Paddock Wood, Kent, England, and used by them for many years on their fruit and hop plantations for "red spider," for which it is specially adapted. It is certain death to red spider, and, being non-poisonous, can be used at any time. It has had most exhaustive trials on the manufacturers' plantations, and has a very large sale in England. "*Spimo*" has been used on Mr. S. Steel's hop plantation, Healesville, Victoria, for two seasons for "red spider" with the greatest success, and also on the "Struan" hop plantations at Bairnsdale, and on various hop gardens at Everton and Briagolong.

Prices : 1-gal. tins, 5s. each ; 5-gal. drums, 22s. 6d. ; 40-gal. casks, £8 each. One gallon makes 100 gallons wash.

"*Spimo Improved*" is a complete wash for all insects, and is specially destructive to aphids or fly, American blight, caterpillars, plant bugs, jumpers, thrip, codlin moth, scale, pear and cherry slug, "red spider," mildew, and all insect pests. This wash is the result of a long series of experiments and careful trials, carried on during many years on Messrs. White's extensive hop and fruit plantations, at Paddock Wood, Kent, England. It is non-poisonous, and is in a perfectly liquid form, and mixes instantly with hard or soft cold water.

Prices : 1-gal. tins, 6s. each ; 5-gal. drums, 27s. 6d. each ; 40-gal. casks, £10. One gallon makes 80 gallons wash. Testimonials and further particulars can be obtained from the agent.

S. LOWE, Nelson-street, Abbotsford.

Lowe's Patent "Soaperine."—The Destroyer of Insect Pests.—A sure and speedy remedy, without fear of injury to the most delicate plant or foliage :—

Lowe's Patent Soaperine Emulsion,
 Lowe's Kerosene Emulsion,
 Lowe's Nicotine Emulsion,
 Lowe's Carbolic Emulsion,
 Lowe's Bi-sulphide of Carbon Emulsion.

It will destroy the following pests :—Rutherglen bug, aphids blight, caterpillar, red spider, &c.

Directions :—1 lb. of Soaperine dissolved in 5 gallons of cold water sprayed on the affected parts.



Fig. 1.—THE DONCASTER SPRAY PUMP.

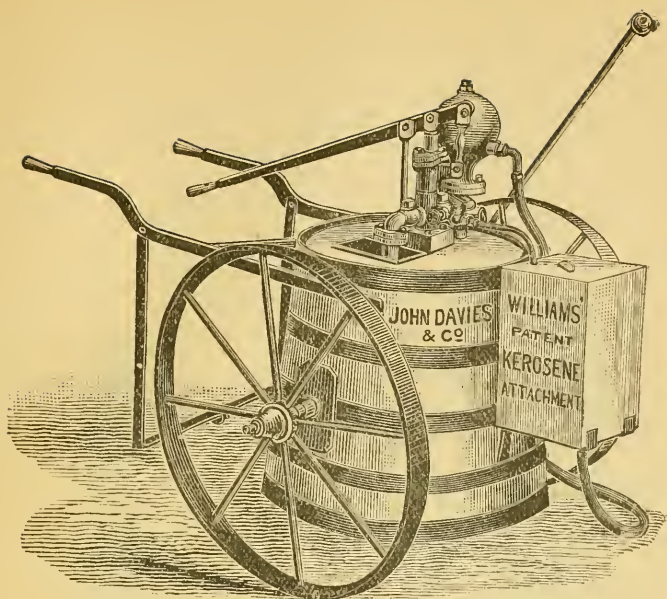


Fig. 2.—PUMP FOR PARKS AND GARDENS.

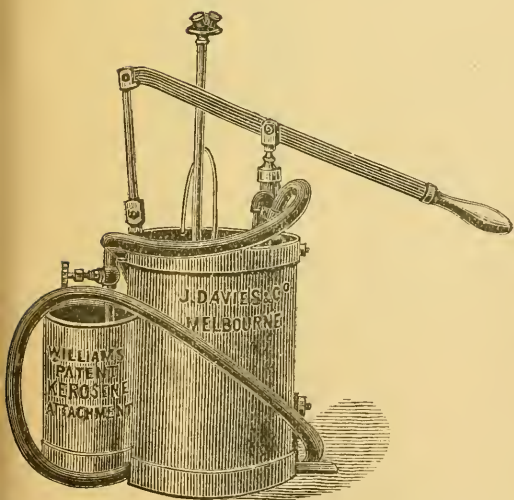


Fig. 3.—SMALL HANDY PUMP, WITH KEROSENE ATTACHMENT.

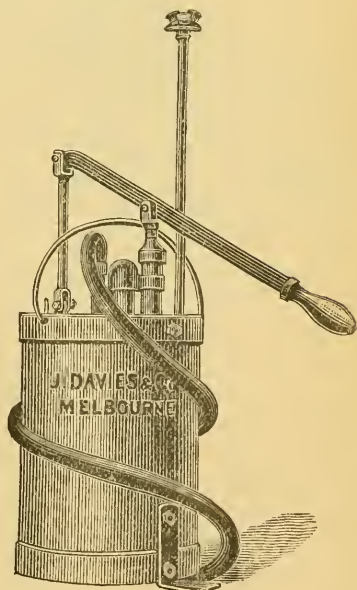


Fig. 4.—SMALL HANDY PUMP, WITHOUT KEROSENE ATTACHMENT.

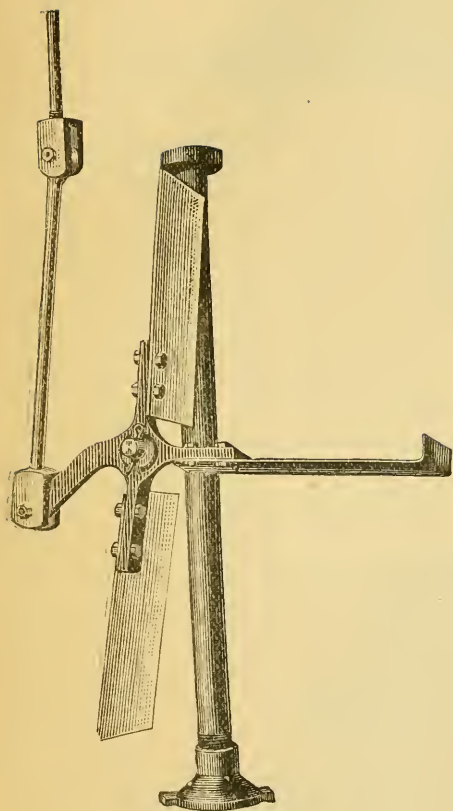


Fig. 5.—DAVIES' PATENT AGITATOR.

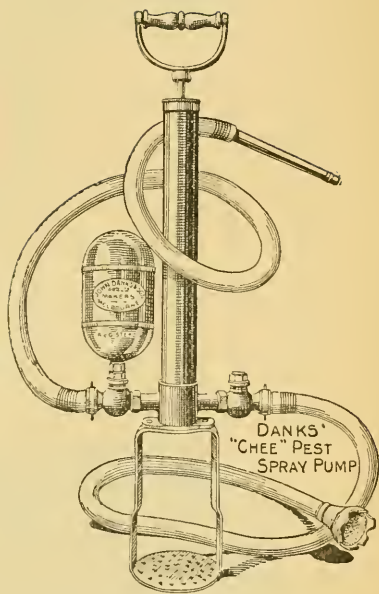


Fig. 6.—THE DANKS "CHEE" PEST SPRAY PUMP.

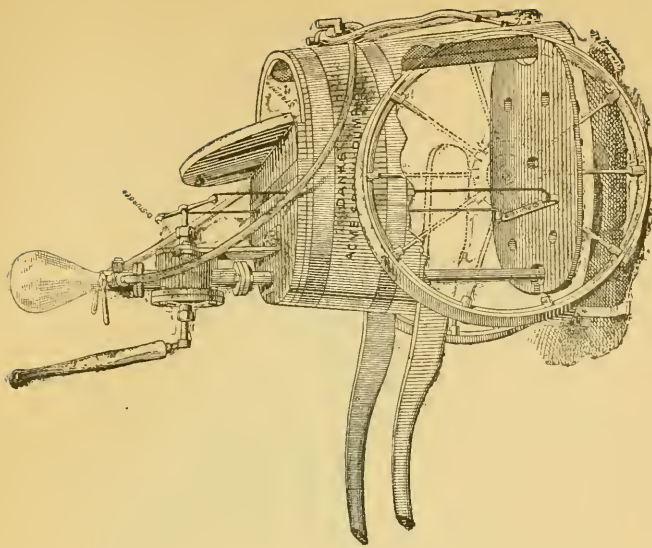
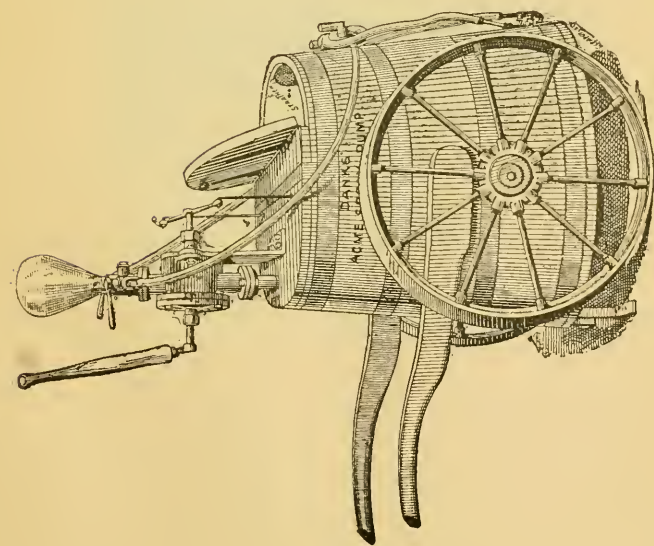


Fig. 7.—THE DANKS IMPROVED ACME SPRAY PUMP.



Fig. 8.—THE DANKS CHALLENGE SPRAY PUMP.

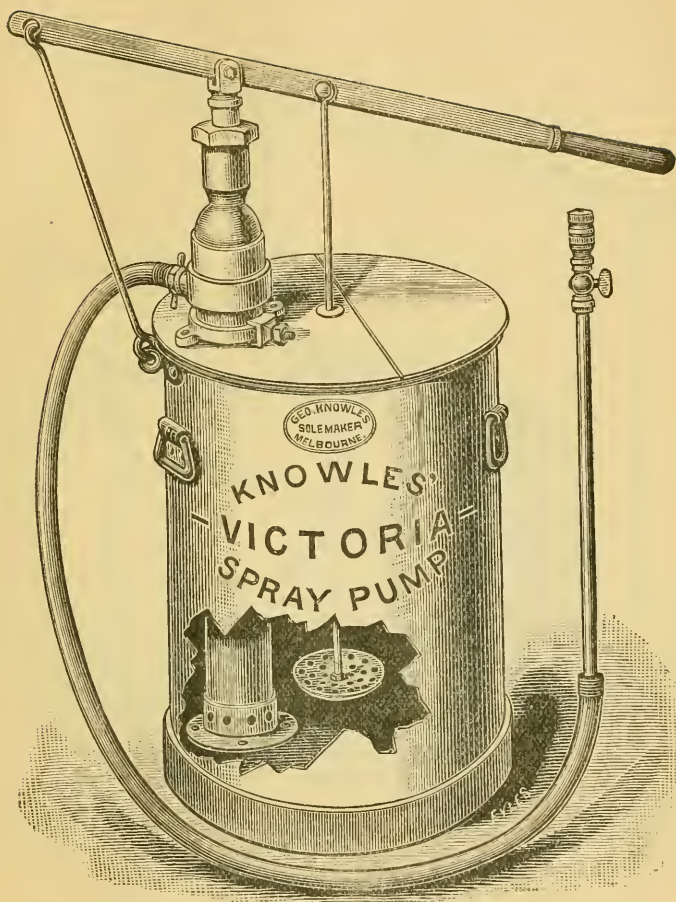


Fig. 9.—KNOWLES' VICTORIA SPRAY PUMP.



Fig. 10.—KNOWLES' ORCHARDIST SPRAY PUMP.

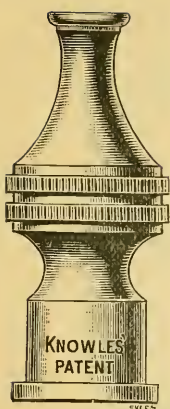


Fig. 11.—THE TRIUMPH
SPRAY NOZZLE.

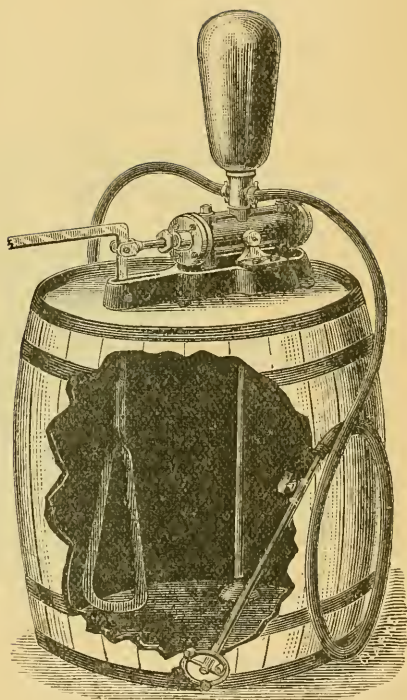


Fig. 12.—THE CHAMPION.

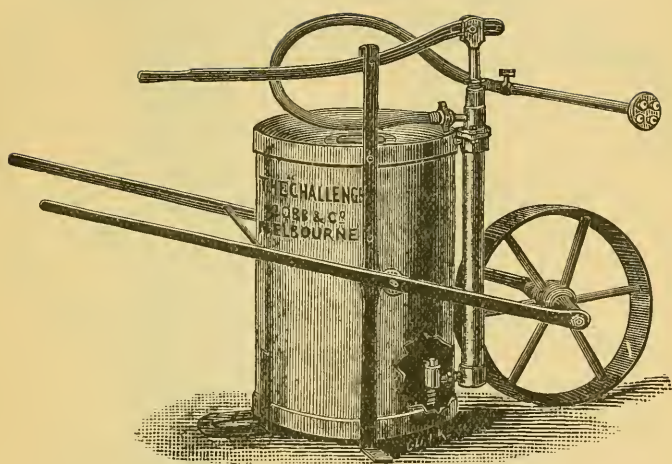


Fig. 13.—THE CHALLENGE.



Fig. 14.—UNSWORTH'S PATENT SPRAY PUMP

APPENDIX III.

REMEDIES AND DEVICES FOR THE DESTRUCTION OF
LOCUSTS, FROM U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF ENTOMOLOGY, BY THE
LATE PROFESSOR RILEY.

THE RILEY LOCUST-CATCHER.

(See Fig. 15.)

Invented by the late Professor Riley, M.A. Ph.D., of the United States Entomological Commission. It is intended to do away with all extra material, like coal oil, which in the long run is expensive, and to work at all seasons, whether the insects are just hatching or full grown. It was worked at Manhattan, Kansas, and gave great satisfaction. The machine operates upon the bagging principle. It is, briefly, a large canvas bag stretched upon a light but strong frame, and placed upon runners, which extend with curved tips a little in front of the mouth. The canvas is stretched upon the inside of the frame, thus making the bag smooth and even within. This bag has a mouth (A) 10 feet long and 2 feet high, and converges backward to a small box or frame, 1 foot square, with a slide cut off (D). This box forms the mouth to a secondary bag (B), $2\frac{1}{2}$ feet long and 1 foot in diameter, which ends in a second frame, having two short runners below it. There is a sliding door (E) of wire gauze in the end frame, and the secondary bag is strengthened by a couple of strips of leather connecting the two small frames. The machine is made to "take more land" by means of two right-angled triangular wings (C) about 6 feet long, that hinge to the upright ends of the large frame in such manner that the rectangle joins the upper corner of the frame. From the lower side of this wing are suspended a number of teeth or beater, which, swinging loosely, drive the locusts inward. The machine is handled by means of two ropes hitched to the outer runners or to the outer and lower side of the mouth of the frame. "On smooth ground the machine can be easily hauled by two men, but where the grass is tall and thick it pulls harder. The locusts, on hopping into the machine, soon reach the small back portion, enter the small bag, and are attracted to the rear end by the light which enters the gauze door. When a sufficient number are thus captured the machine is stopped, the cut-off is slid down in front of the secondary bag, a hole is dug behind the machine, the bag tipped into it, and the insects buried. A strip of leather closes the slit through which the cut-off slips, and the main bag is made of dark cloth, while the secondary bag is white, so by contrast to attract more thoroughly the locusts.

“The advantages of this machine are that it requires no additional expense to run it, as for oil, tar, &c. It will catch the winged locust as well as the young, if operated on cool mornings and evenings, and is adapted to almost all conditions of growing grain. The machine can be made for about \$10, and perhaps less.” In practice we find it best to draw the machine by hitching to the runners, and to brace the wings at desired angles, according to the strength of the wind, by means of two iron rods, as in illustration.

THE FLOREY LOCUST MACHINE.

(See Figs. 16 and 17.)

This contrivance, put up by J. S. Florey, of Greeley, Colorado, is worthy of mention in this connexion; for, while it may be used with coal tar, it is essentially a catching and crushing machine.

The main feature of this invention is a revolving platform of heavy canvas or wire-cloth, which runs between two horizontal rollers. Long arms reach forward, which support a revolving reel; from these arms downward extend sheet-iron sides, over the top a canvas covering; all so constructed as to form a large wide mouth, into which the 'hoppers are driven by the arms of the revolving reel and carried between the two rollers and crushed. Horizontal strips running along the rollers serve to keep the rollers and platform clear of the crushed grasshoppers. The whole machine is supported on two main wheels about the middle and two smaller ones in front. Extending back is a frame or crossbar, to which one or two horses may be hitched to push the machine forward, or it may be operated by hand. The front of the platform runs close to the ground, and by bearing down at the rear by the driver it can easily be lifted over any obstruction that may be in the way. The machine can be raised or lowered in front to suit the crop over which it is run.

This invention will destroy the grasshoppers without the necessity and expense of using oil or tar. The patent, we understand, also covers the combinations of a receptacle immediately under the rollers into which the grasshoppers are carried, and in which, if need be, water and oil may be kept, and also a long, narrow hopper (just over the rollers), into which coal tar may be put and allowed to run through on to the platform, thus making it a self-tarring machine. Either of these combined methods of destroying the 'hoppers may be used as the farmer may choose. The machine is so simple in construction that any ordinary workmen can put them up at a comparatively small price. The machine may be made of any size desired, from a small hand machine to one a rod or more in width.

THE ANDERSON COAL-OIL CONTRIVANCE.

(See Fig. 18.)

This contrivance was constructed by President John A. Anderson, for use on the Agricultural College Farm, at Manhattan, Kansas. It was found to do very good service, killing the young locusts in considerable numbers. The oil did not evaporate so rapidly as was anticipated. One thorough saturation was sufficient for fifteen or twenty minutes, when a little more could be added. If the machine be hauled against the wind nearly all the locusts which hop will touch the oiled canvas. They generally take several hops upon the canvas before leaving it, thus insuring a thorough saturation with the oil. After hopping from the apron they can take two or three hops upon the ground, then lose all power in their hind legs, stretching them straight out behind, and finally, in one or two minutes after being "oiled" they are dead.

Coal Tar.—This may be used with most of the contrivances just described for the use of kerosene, and while not equal to the simple kerosene pan for speed in trapping and destroying, is yet very useful, especially where the coal-tar can be obtained at nominal cost from gas-works. It also permits the use of the simplest kind of pan. Enough tar is spread over whatever receptacle may be used to cover well the bottom, and when this becomes sufficiently matted with the young locusts so as no longer to destroy the new comers, another coating is added, and so on until it becomes necessary to remove the whole mass, when it is shovelled from the pan and burned; or, what is far preferable, wherever there are wet ditches it may be thrown into these, when the oil contained in it, spreading over the surface of the water, destroys such locusts as may jump into or be driven into such ditches. Where the tar is scarce, as a matter of economy it will pay to melt the accumulated mass in iron vessels. By skimming off the dead locusts that rise to the surface, and thinning the residuum with a little coal-oil, it may be used again.

THE ROBBINS COAL-TAR PAN.

(See Fig. 19.)

A simple pan extensively employed, and which is known as the Robbins "hopperdozer," is shown, the general plan being that of the ordinary road-scraper. Its simplicity and durability account for its general use. It was usually drawn by hand, though several pans were frequently bound together and drawn by horses; while, in some instances, certain improvements in the way of mounting on wheels, so as to permit its being pushed from behind, were also adopted. We saw some with a wire screen or cover hinged to the back, so that the insects might be secured when the pan was not in motion, but the cover seemed superfluous. We also saw lime and kerosene mixed so as to form a mortar substituted for the coal-tar.

SIMPLE COAL-OIL PAN.

(See Figs. 20 and 21.)

A good and cheap pan is made of ordinary sheet iron, 8 feet long, 11 inches wide at the bottom, and turned up a foot high at the back and an inch high at the front. A runner at each end, extending some distance behind, and a cord attached to each front corner complete the pan at a cost of about 6s. We have known from 7 to 10 bushels of young locusts caught with one such pan in an afternoon. It is easily pulled by two boys, and by running several together in a row, one boy to each outer rope, and one to each contiguous pair, the best work is performed with the least labour. Longer pans, to be drawn by horses, should have transverse partitions (Fig.) to avoid spilling the liquid; also more runners. The oil may be used alone so as to just cover the bottom, or on the surface of water, and the insects strained through a wire ladle. When the insects are very small, one may economise in kerosene by lining the pan with saturated cloth, but this becomes less efficient afterward, and frames of cloth saturated with oil do not equal the pans. Where oil has been scarce, some persons have substituted concentrated lye, but when used strong enough to kill it costs about as much as the oil. The oil pans can be used only when the crops to be protected are small. Small pans for oil, attached to an obliquing pole or handle, do excellent service in gardens.

THE PRICE OIL PAN.

(See Fig. 22.)

This contrivance was invented by Mr. A. A. Price, of Rutland, Humboldt County, Iowa; he sends the Commission the following description of a coal-oil pan to be drawn on runners, and which was used with much success in America:—

Take a common board from 12 to 16 feet in length for the foundation or bed-piece. Make a tin trough 4 inches deep, 6 inches wide, and as long as required. Divide the trough into partitions by means of strips of tin, so that each partition is a foot long, thus avoiding the spilling of oil. Back of this place a strip of tin 16 inches wide and as long as the trough. The back must be firmly secured by braces running down to the front edge of the board. Under all this place three wooden runners 3 feet long, and shod with iron, for the trough to ride on. Fill the pan half-full of water, and then add a small quantity of kerosene, sufficient to cover the water. A horse may be hitched to the machine by fastening a rope to the outside runners. The lightness of the machine will allow of its being used on any crops.

THE KING SUCTION MACHINE.

(See Figs. 23 and 24.)

This machine was invented by Mr. J. A. King, of Boulder, Colorado. It consists of two large tin tubes, about 8 inches in diameter, with flattened, expanded, and lipped mouthpieces, B, running near the ground. This horizontal opening or mouth is about 7 feet long. The tubes connect at the upper extremity with a chamber, C, in which is a revolving fan, which makes about 1,200 revolutions per minute. The tubes and fan, with the gearing, are placed in a frame, D, 5 by 10 feet, mounted upon two large driving wheels. E E plate represents this machine in operation.

The air current made by the revolving fan creates a suction at the mouth, which draws the insects up the tubes and into the chamber. They are then thrown by the fan upon a wire screen, and from thence drop into a kind of hopper, which conducts them to a bag. The wire screen rapidly chokes up and must be frequently cleaned. Most of the locusts are crushed and mangled by the rapidly-revolving fan, so that the screen may be removed entirely and the locusts thrown out behind. This machine works well on smooth ground or in a wheat field while the wheat is yet short. The principle of the machine is a good one, and we see no reason why some cheaper modification of it should not be quite generally used early in the season. The lips might be protected and less liable to bend and get out of order by moving on runners made to extend some distance in front.

THE PETELER LOCUST-CRUSHING MACHINE.

(See Figs. 25 and 26.)

This apparatus was devised by Mr. F. Peteler, of Minneapolis, Minnesota. In a communication from the inventor, dated 8th June, 1877, the following description is given. The machine is intended to be drawn by horses, the drawing representing one to be drawn by a team:—"The frame is mounted upon two wheels. The front is a sheet-iron platform, over which revolves an elevator made of slats, which carry the locusts into boxes, where they pass between rollers, are crushed, and fall to the ground. The sides and top or back are wire screws, the whole forming a scoop 16 feet long (on the bottom 19 feet), 8 feet high, the top of which can be lowered or raised according to the height of the grain or grass."

A more detailed description follows:—A A, driving-wheels; B, guiding-wheel; D, setting-lever; d, retaining-post; G, endless carrier; Hh, gearing for elevator and crushing-shaft; I, crushing-

rollers ; L, set-screw to spiral spring ; l, spiral spring to press rollers together when necessary ; N, slats on endless chain with sheet-iron projections to hold the locusts ; M, drag-chain (or strips of light wood) to stir the locusts.

To use Mr. Peteler's own words :—"This machine is intended for local or State authorities to use on uncultivated lands adjoining farms and unsettled prairies, in order to destroy the insects during the entire season. For that purpose, there should be proper organization, with camp outfit, &c., to follow up the swarms, loading the machines on waggons, and battle with the 'hoppers morning and evening, when they are comparatively sluggish. If they use them only 60 days during the season, and go over only 40 acres per day, destroying but one-half bushel per acre (frequently they would destroy 8 to 10 bushels per acre), they would send 25,000 bushels daily, or 1,500,000 in 60 days, where bad 'hoppers go."

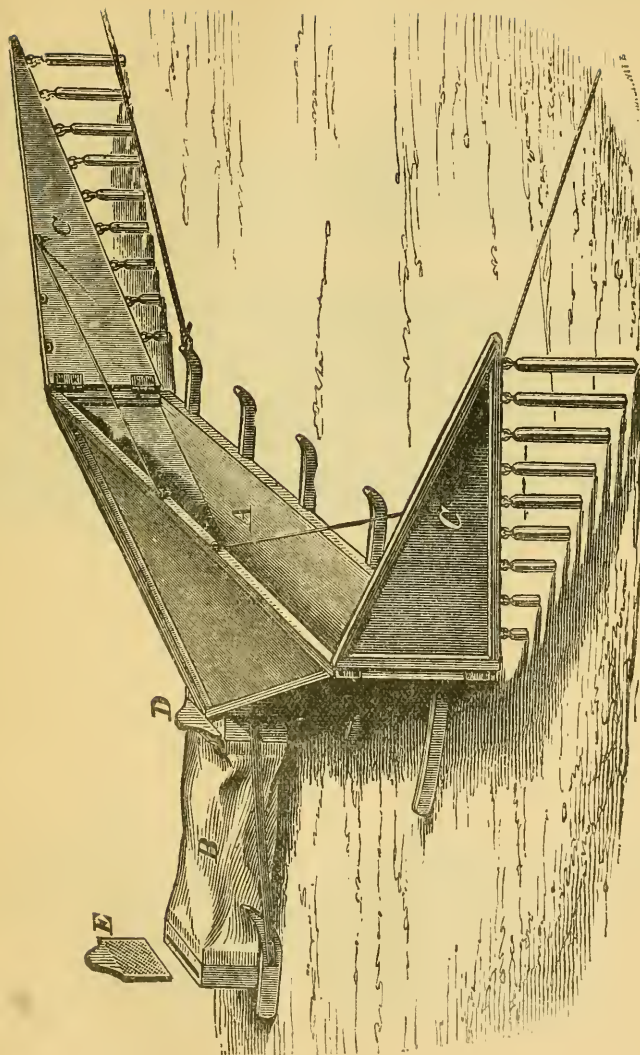


Fig. 15.—THE RILEY LOCUST-CATCHER.

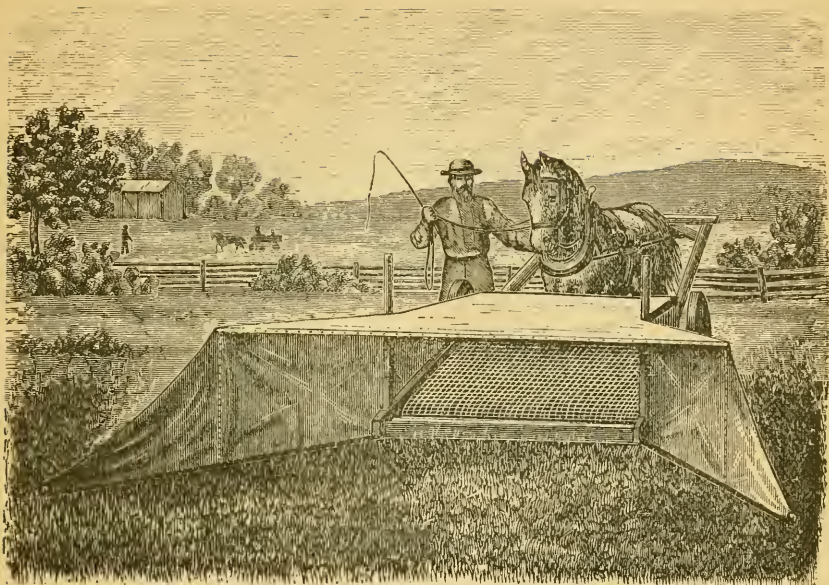


Fig. 16.—THE FLORY LOCUST MACHINE.

Front view, in operation.

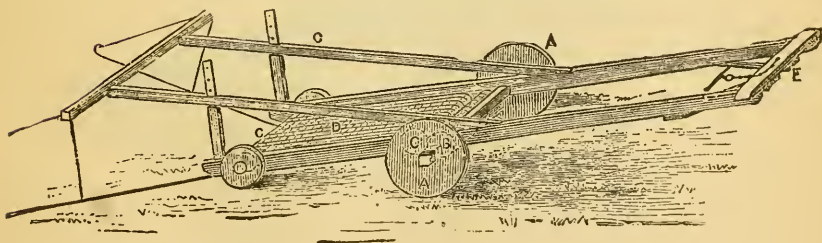


Fig. 17.—THE FLORY LOCUST MACHINE.

Side view of frame.

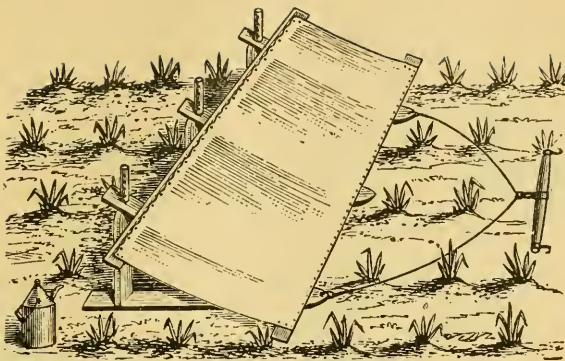


Fig. 18.—THE ANDERSON COAL-OIL CONTRIVANCE.

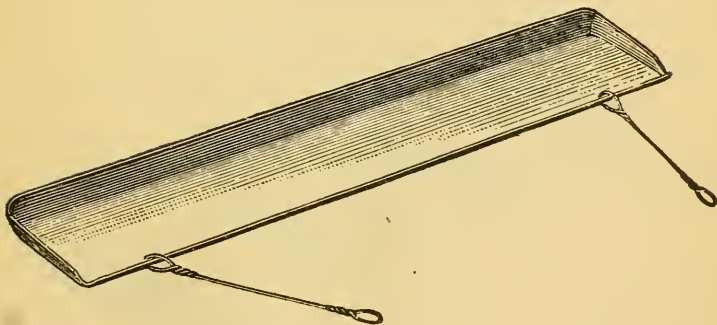


Fig. 19.—THE ROBBINS COAL-TAR PAN.

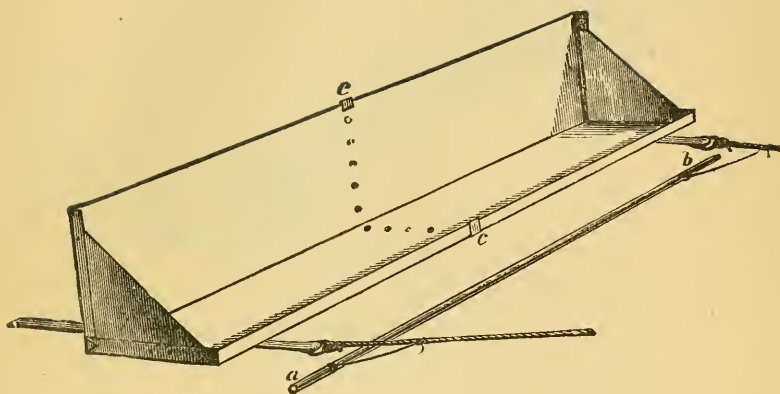


Fig. 20.—SIMPLE COAL-OIL PAN.

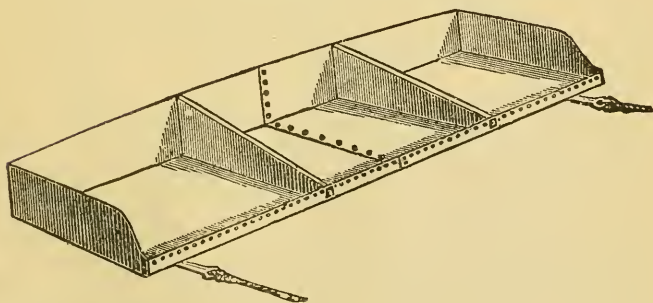


Fig. 21.—COAL-OIL PAN.

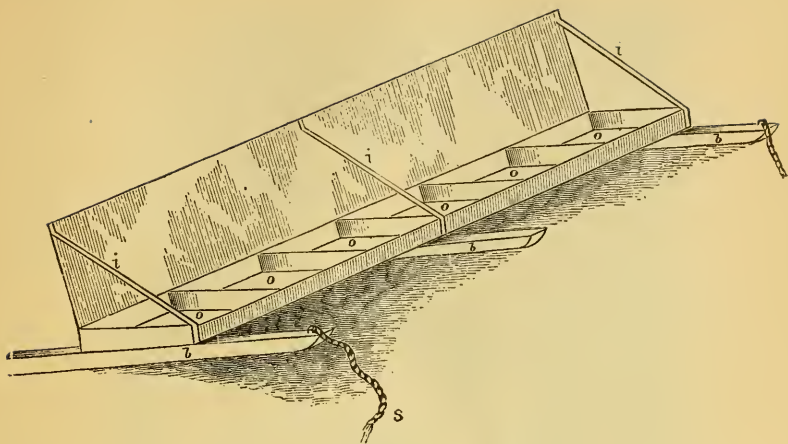


Fig. 22.—THE PRICE OIL PAN.

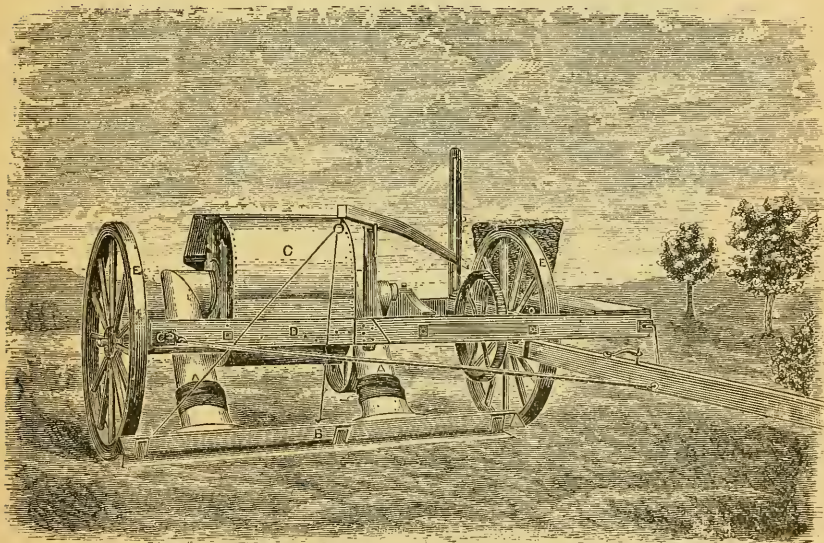


Fig. 23.—THE KING SUCTION MACHINE.

Front view.

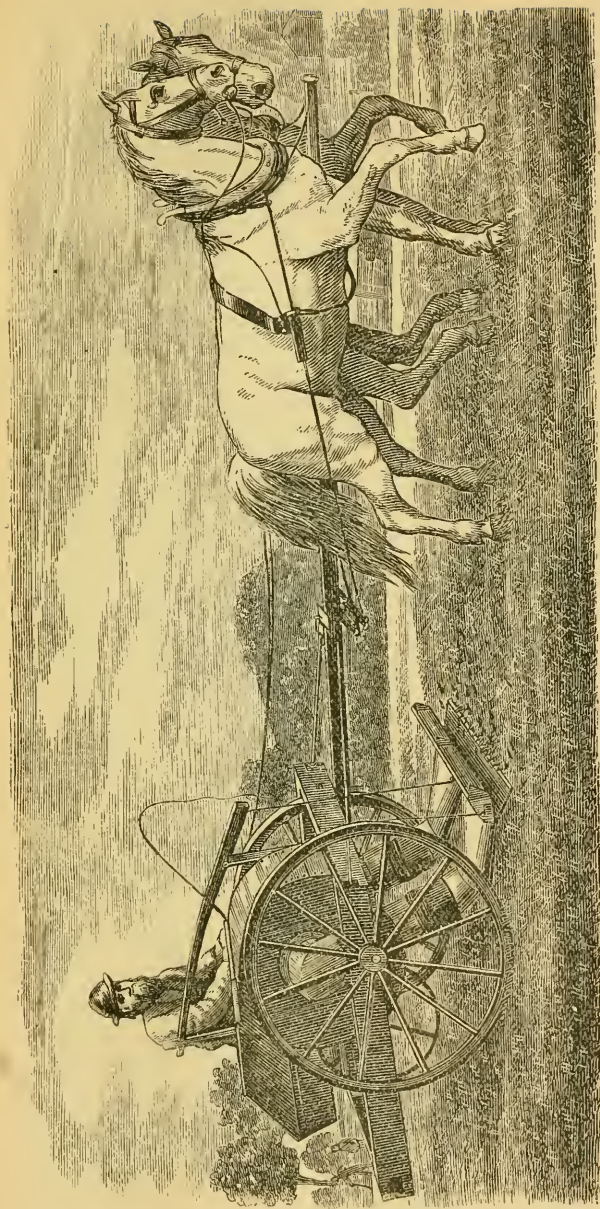


Fig. 24.—THE KING SUCTION MACHINE. Side view, in operation.

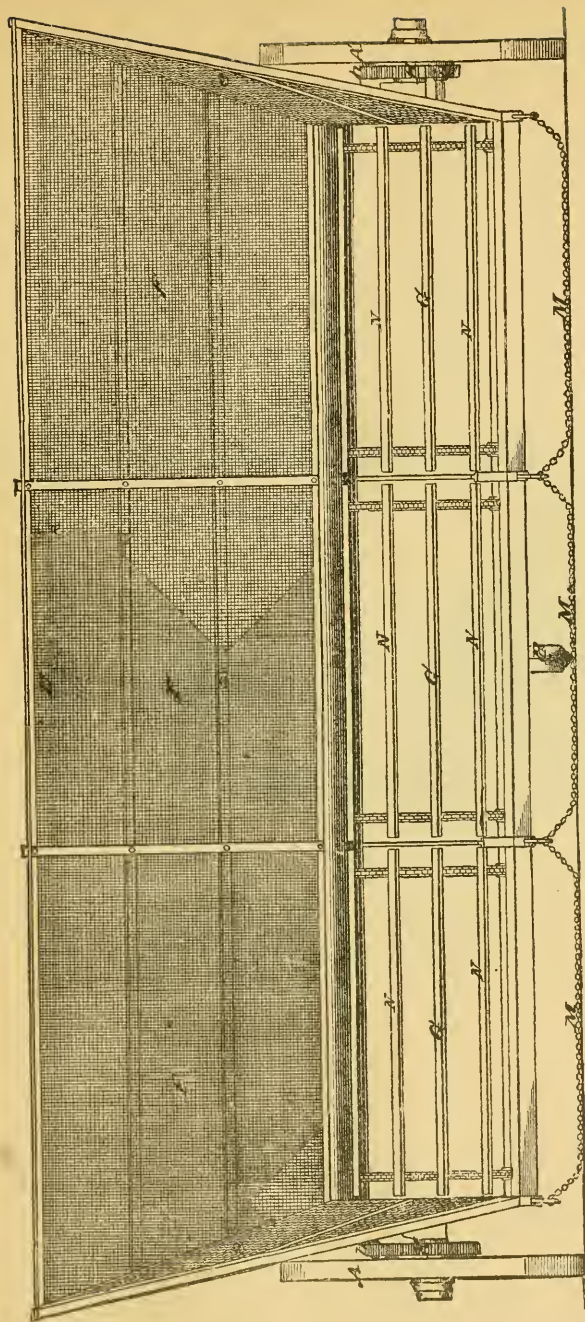


Fig. 25.—THE PETELER LOCUST-CRUSHING MACHINE.
Front view.

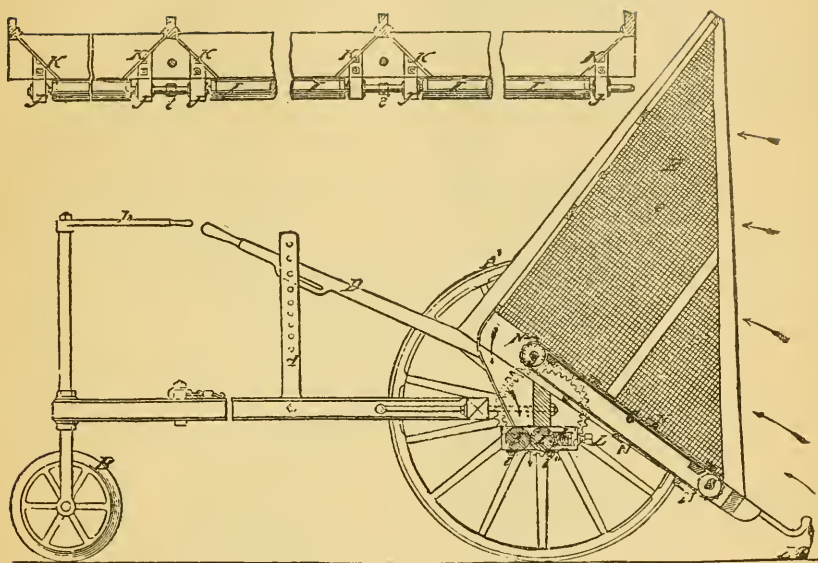


Fig. 26.—THE PETELER LOCUST-CRUSHING MACHINE.

Side view.

GENERAL INDEX TO PART III.

A.

- Acacia* Borer, 125; D. Best, notes on, 125; destroying *Acacia longifolia*, 125.
Acacia dealbata, Belus destructive to, 45.
Agarista glycine, 145.
Agrotis sp., 75.
Agrotis spina, 77.
Allomicrus exiguus, 137.
Antherea eucalypti, 113.
Antherea helena, 113.
Apple Bacculatrix, 130.
Apple Tree Borer, round-headed, 137.
Apple Trees, *Saperda candida* destructive to, 137.
Apricot Beetles, 45; remedies against, 46.
Artamus leucogaster, 141.
Artamus personatus, 142.
Artamus sordidus, 142.
Artamus superciliosus, 139.
Aspidiotus perniciosus, 85.

B.

- Bacculatrix poniifotella*, 130.
Banksia Beetle, triangular-marked, 135; destroying *Banksia integrifolia*, 135.
Banksia Borer, 67; bisulphide of carbon used against, 69; carbolic acid, 69; creosote, 69; destroyed by *Asilidæ*, 69; destroying *Banksia integrifolia*, 67; destroyed by "*Vocconia*" spiders, 69.
Banksia Moth, 121; destroying *Banksia*, 121.

- Batocera Wallacei*, 137.
Belus, 45.
Benzine Emulsion, 15.
Birds, Insect-destroying, 139.
Bisulphide of Carbon Emulsion, 182.
Bisulphide of Carbon, used against *Banksia* Borer, 69; against *Locusts*, 30.
Blight Cure, 180.
Blue Gum Moth, 55; kerosene emulsion for, 56.
Bordeaux Mixture, used against *Plum Aphis*, 64.
Bugong Moth, 77; Mr. Oliff, notes on, 77.

C.

- Cacoma i pallidus*, 145.
Cœquosia triangularis, 113.
Calandra, 46.
Carbolic Acid, used against *Banksia* Borer, 69; against *Wattle Goat Moth*, 109.
Carbolic Emulsion, 182.
Caper Butterfly, 101; *Capparis* destroyed by, 102; E. Anderson and F. Spry, notes by, 101; *Hellebore* used against, 104.
Casuarina, destroyed by *Frenchia casuarinæ*, 127.
Ceraphron triticum, parasitic on *Corn Aphis*, 42.
Chelepteryx Collesi, 113.
Climacteris leucophœa, 157.
Climacteris scandens, 155.
Corn Aphis, parasitic enemies of, 42; *Syrphus torvus* and *Ceraphron triticum* parasitic on, 42.

Creosote-oil, used against *Banksia* Borer, 69 ; Locusts, 30.

Cuckoo, narrow-billed bronze, 143 ; A. J. North on, 143 ; habits of, 143.

Cuckoo, pallid, 145 ; destroying *Agrotis*, 145 ; destroying Cutworms, 145 ; destroying Vine Caterpillar, 145 ; Dr. Ramsay, on distribution of, 146 ; J. Gould, notes on, 146.

Cutworms, *Calosoma Schayeri* attacking, 82 ; *Calosoma sycophanta* attacking, 82 ; C. French, jun., notes on Fungus destroying, 80 ; trench system for, 79.

Cutworm Moths, 75 ; H. Tryon, observation on, 76.

Cyria imperialis, 67.

D.

Danima banksiæ, 121.

Danthonia, destroyed by *Heliothis*, 80.

E.

Eucalyptus : *Antheræa eucalypti* destructive to, 114 ; Gum Saw Fly destructive to, 117 ; *Hyleora* destructive to, 122 ; *Mnesampela privata* destructive to, 55.

Eucalyptus viminalis : Gum Emperor Moth destructive to, 114.

F.

Fantail, white-shafted, 151 ; Cayley, notes on, 152 ; A. J. North, notes on, 152 ; J. Gould, notes on, 152.

Fir-tree Oil, 180.

Fish oil Soap used against San José scale, 91.

Flycatcher, restless, 149 ; A. J. North, notes on, 149 ; Cayley, notes on, 150 ; J. Gould, notes on, 149.

Fumigation in Victoria : Burnley Gardens, 171 ; Dr. Coquillett on, 159 ; useless against fungous diseases, 172.

G.

Gishurst compound (patented), 180.

Grasshopper preventative, 180.

Gum Emperor Moth, 113 ; Paris green used against, 114 ; destroying *Schinus molle*, 114 ; *Eucalyptus viminalis* destroyed by, 114.

Gum Saw Fly, 117 ; destroying *Callistemon*, 118 ; destroying *Eucalyptus*, 117 ; kerosene emulsion used against, 118.

H.

Heliothis armigera, 49 ; C. French, jun., notes on fungus attacking, 80 ; fungus attacking, 80 ; Professor C. V. Riley, notes on, 79 ; trench system for, 79.

Hellebore Mixture, 180 ; powder (English), 180.

Hellebore, used against Caper Butterfly, 104.

Hydrocyanic acid-gas, for deciduous trees, 166 ; for glasshouse fumigation, 169 ; for nurseries, 162 ; for orchards, 162 ; how to prepare, 159 ; treatment, 159 ; treatment for dwelling fumigation, 170 ; used against Leaf Tunneller, 72.

Hyleora : Destructive to eucalypts, 122.

I.

Insect-extermimating fluid (Bradbury's), 181.

K.

Kangaroo grass, destroyed by *Heliothis*, 80.

Kerosene emulsion, 180-2 ; used against Blue Gum Moth, 56 ; Gum Saw Fly, 118 ; Leaf Tunneller, 72 ; Locusts, 31 ; Plum Aphis, 64 ; San José Scale, 89 ; Vine Curculio, 61.

Kilemquick, 181.

L.

- Lamprococcyx basalis**, 143.
- Leaf Tunneller**, 71; hydrocyanic acid-gas used against, 72; kerosene emulsion, 72; *Sonchus*, breeding grounds for, 71; tobacco smoke used against, 72; tobacco water, 72.
- Lethorion Carbon Cones**, 181.
- Leto Staceyi**, 110.
- Lime**, salt, and sulphur mixture for San José scale, 90.
- Locusts**: Bisulphide of carbon used against, 30; castor oil plant, 30; common Victorian, 27; cost of screens for, 30; creosote-oil used against, 30; dipterous flies (*Masicera pachytilis* and *Tachina cedipodæ*) destroying, 31; eggs, Mr. Olliff on destruction of, 32; egg-laying, favorite places for, 28; fungus, 31; fungus, Inspector Cock's experiments with, 34; fungus, preparation of, 36; kerosene emulsion used against, 31; machines, Anderson coal-oil contrivance, J. A. Anderson, Kansas, United States, 205; "Florey," J. S. Florey, Colorado, United States, 204; "King" suction, J. A. King, Colorado, 207; "Locust catcher," Prof. Riley, United States, 204; "Peteler" crushing, F. Peteler, Minnesota, United States, 207; Mr. Buggy, Corowa, N.S.W., note on Braconid flies destroying, 31; Mr. Olliff, notes on, 33; Mr. Peringuey, report on, 80; Paris Green used against, 31; preparation for destroying, 31; principal breeding-grounds, 33; Prof. Riley, on destroying eggs of, 33; on preventing Locusts from ascending trees, 33; remedies and devices for destruction, United States Department of Agriculture, Washington, 203; R. Helms, notes on the habits of, 27;

Robbins' coal-tar pan for, 205; screens, 29; simple coal-oil pan for, 206; Trombid Mite destroying, 31; value of birds for destroying, 31.

London Purple, 181.

M.

- Mamestra Ewingi**, 75.
- Mnesampela privata**, 55.
- Mucor racemosus**, 31.
- Myzus sp.**, 63.
- McAlpine, D.**, combination mixture for spraying, 99.
- Nicotine Emulsion**, 182; soap, 181.
- Nikoteen**, 181.

O.

- Opuntia**, common, for rendering canvas airtight, 161; Engelmanni, for rendering canvas airtight, 161.
- Orthorrhinus cylindrostris**, 61, O. Klugii, 60.

P.

- Pachytelus australis**, 27.
- Painted Apple Moth**, 27; destroying *Acacia pycnantha*, 95; Paris Green used against, 98; W. W. Froggatt, notes on, 95.
- Palm Weevils**, 46.
- Paris Green**, 181; A. N. Pearson, formula for, 99; (Blundell's) 181; used against *Banksia* Moth, 122; Gum Emperor Moth, 114; Locusts, 31; Painted Apple Moth, 98; Tomato Moth, 51.
- Pepper Tree**, *Schinus molle*, destroyed by Gum Emperor Moth, 114.
- Perga dorsalis**, 117.
- Pestide Compound**, 181.
- Phytomyza affinis**, 71.

Pielus, 113.

Pieris teutonia, 101.

Piesarthrius marginellus, 125.

Plum Aphis, 63; Bordeaux Mixture used against, 64; kerosene emulsion 64; resin compound, 64; tobacco and soap, 64.

Pontia rapi, 104.

Q.

Quibell's Insect Exterminator, 181.

R.

Resin Compound, used against Plum Aphis, 64.

Resin Wash, 180.

Rhipidura albiscapa, 151.

Ricinus communis, 30.

S.

San José Scale, 85; destroyed by fungus *Sphaerostilbe coccophila*, 91; fish-oil soap used against, 91; fumigation for, 162; fungus destroying, 91; hydrocyanic acid-gas used against, 93; kerosene emulsion, 89; lime, salt, and sulphur mixture for, 90: Professor Howard, notes on, 87; Professor Smith, notes on fungus destroying, 91; soap wash used against, 91.

Scale Insects, C. P. Lounsbury, fumigation for, 162.

Seisura inquieta, 149.

Siphonophora sp., 41.

Soaperine Emulsion, 182.

Soaperine (Lowes), 182.

Soap Wash, used against San José Scale, 91.

Spimo, 182; improved, 182.

Spraying Machines, G. Knowles, 176; J. Davies and Son, 173; J. Danks and Son, 175; T. McAlpine and Co., 178; W. Unworth, 179.

Spray Pumps, illustrations of, 173.

Syrphus torvus, parasitic on Corn Aphis, 42.

T.

Tea Tree, destroyed by *Cecidomya*, 127.

Teia anartoides, 95.

Themeda, destroyed by *Heliothis*, 80.

Tinea granella, 129.

Tineid Moths, Prof. Comstock on, 130.

Tobacco, 181; juice, 181; powder, 181; smoke used against Leaf Tunneller, 72; water used against Leaf Tunneller, 72.

Tobacco and Soap used against Plum Aphis, 64.

Tomato Moth, 49; Mr. Oliff, notes on, 50; Paris Green used against, 51; poisoned baits for, 51.

Tree Creeper, Brown, 155; A. J. North, notes on, 155; J. Gould, notes on, 155.

Tree Creeper, White-throated, 157; J. Gould, notes on, 157.

Turpentine Emulsion, 180.

U.

Uracanthus bivitta, 136; *U. cryptophaga*, 136; *U. simulans*, 136; *U. triangularis*, 135; *Odynerus* parasitic on, 137.

V.

Vegetation Diseases Act, report on the working of same, 17.

Vegetation Diseases, an Act relating to Disease affecting Vegetation, 7.

Vine Caterpillar, 145.

Vine Curculio, 60.

W

Wallaby Grass, destroyed by *Heliothis*, 80.

Wattle Goat Moth, 107; carbolic acid used against, 109; destroying *Acacia decurrens*, 107; hot steam spray for, 109; Prof. McCoy, notes on, 107.

Wheat Aphis, 41.

Wheat Moth, 129; castor oil plants used against, 131; larkspur plants, 182; strawsonizer for spraying, 132.

Wood Swallow, Common, 142; nesting in *Pinus insignis*, 142.

Wood Swallow, Masked, 142; nesting in *Araucaria excelsa*, 139.

Wood Swallow, White-eyed, 139; A. J. North, notes on, 139.

Wood Swallow, White-rumped, 141; J. Gould, notes on, 141.

Z.

Zeuzera eucalypti, 107, 113; *Macleayi*, destroying *Eucalypts*, 110.



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